HOW TO SPOT
Square Pegs
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Chemical Engineering

OCTOBER 1955

EXCLUSIVE!

A peek at the chemical engineering behind the production of . . .

URANIUM

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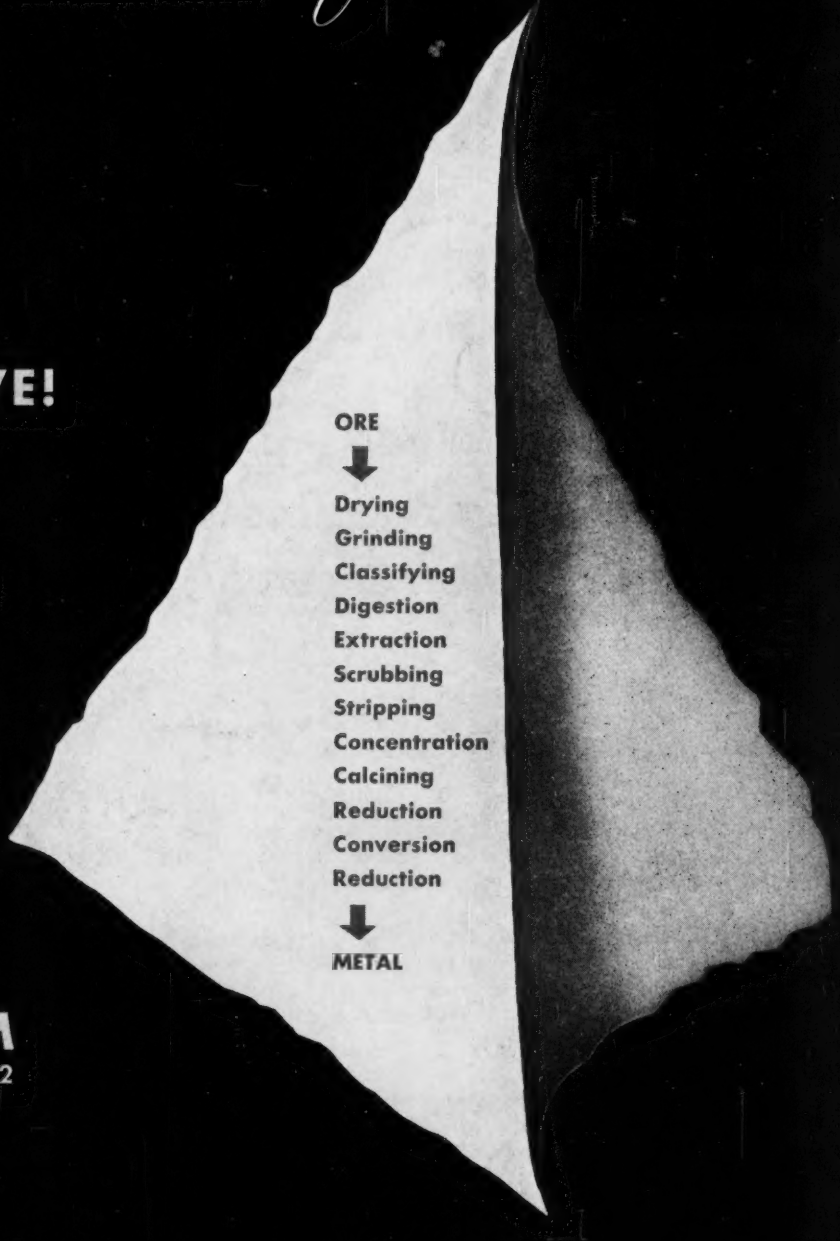

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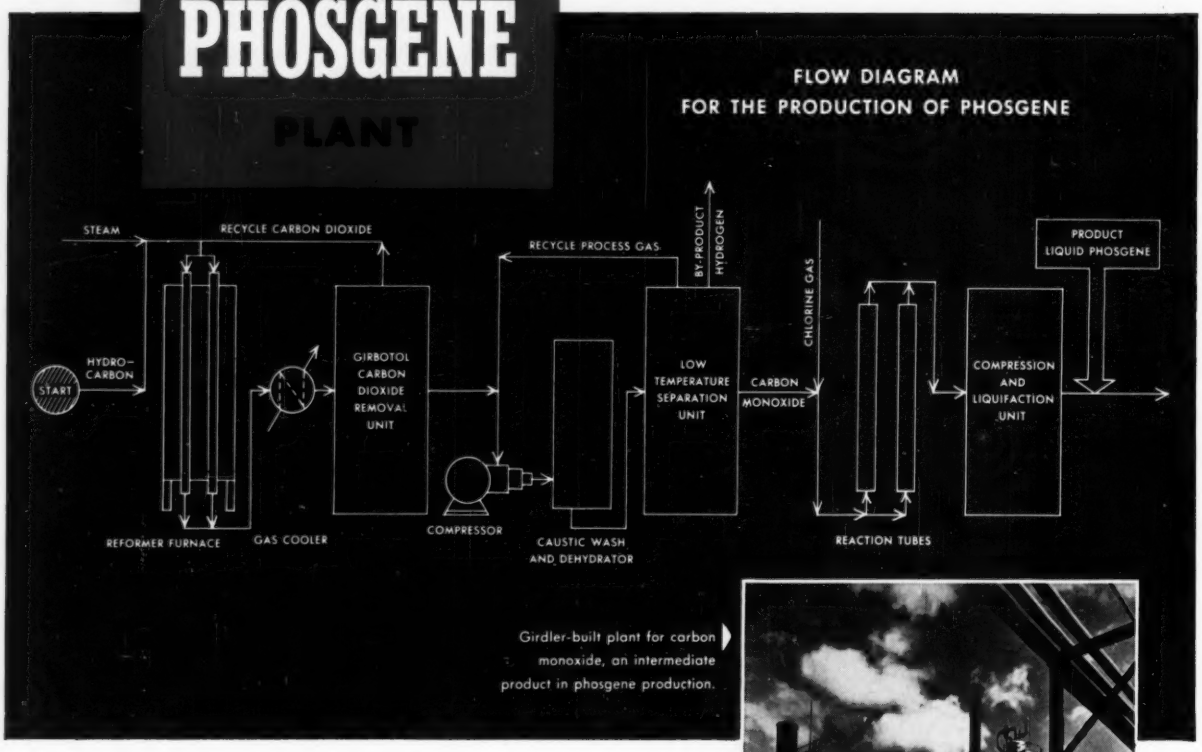
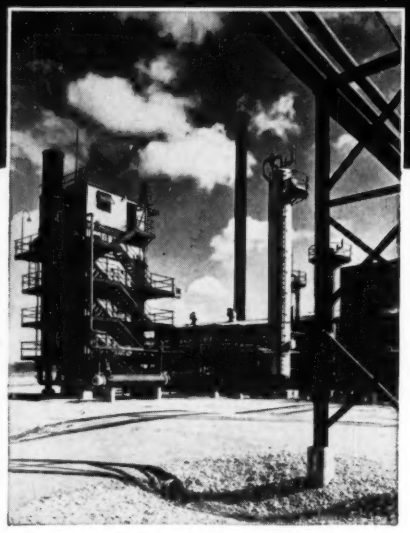
ONE DOLLAR

PHOSGENE PLANT





Girdler-built plant for carbon monoxide, an intermediate product in phosgene production.

Girdler gives you complete design-engineering-construction service

This flow diagram shows a process for producing phosgene—an increasingly important chemical in making many organic products varying from solvents to plastics. An important use is for polyurethanes (isocyanates). This phosgene process uses the Girdler process for producing carbon monoxide and hydrogen from natural gas or other light hydrocarbons, a process notable for high purity and flexibility. In addition to phosgene and carbon monoxide, by-product hydrogen can be produced in any quantity and purity desired.

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Carbon Dioxide Plants	Hydrogen Chloride Plants
Gas Purification Plants	Fertilizer Plants
Plastics Materials Plants	Phosgene Plants
Carbon Monoxide Plants	Formaldehyde Plants

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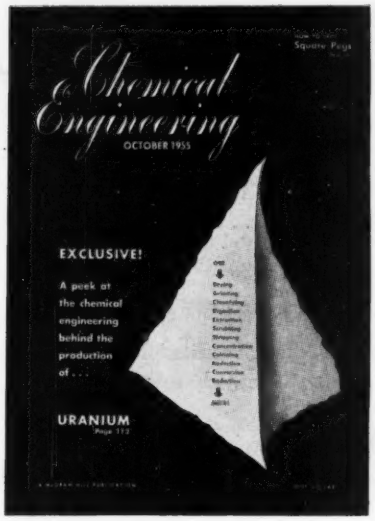
JOHN R. CALLAHAM, EDITOR



• • • **Uranium by novel chemical process.**

Wraps are now off National Lead's big $78 million uranium Feed Materials unit at Fernald, Ohio. Here's an exclusive look at how it converts ore to uranium metal by the latest chemical processing methods. (p. 112)

Drying: theory, equipment, costs.

You'll find here a special, 20-page report on drying as a unit operation. It briefly covers fundamental theory, classifies dryers by a novel method, then goes into a detail evaluation of commercial types of dryers with advantages and limitations of each basic type. The authors' approach is thoroughly practical, their coverage comprehensive (p. 191). Next month's feature report continues on the same subject, will give extensive cost data.

How to protect pressure vessels.

Relief devices are necessary to prevent fires and explosions in pressure systems. Here's practical information on what de-

Please turn page

"Most Needed" Articles

You'll be interested, I'm sure, in the "most needed" topics that CE's editors are now working on.

This is a highly selective list of subjects needed to fill in some of the obvious gaps in the chemical engineering literature.

It includes, for instance, many of the major subjects you've asked us to cover and which our own research has convinced us would be of broad interest and basic value to chemical engineers everywhere.

It includes topics that have never been covered—or covered adequately—for our type of engineer readers.

The list (which now consists of 37 items) cuts across every area of chemical engineering from fluid flow theory to process equipment design, from mass transfer separations to operating labor costs.

We've been working on these "most needed" subjects for over 7 months; some of them will appear soon in CE as feature articles or reports.—JRC

GUIDED TOUR

vices are available; how to select them; the best way to install and use them. (p. 170)

How urea processes stack up . . .

. . . technically, economically. Consultant Tonn surveys seven processes: raw material and energy needs, design and operating highlights, production costs. A study in comparative process economics. (p. 186)

Water . . . how it's treated.

Permutit's Nordell tells how you can treat water for process uses—from ion exchange demineralization, cold or hot chemical processes to coagulation and aeration. Yes, data on costs, too. (p. 175)

More trick, kinks and shortcuts.

Plant Notebook brings how-to tricks to save you time and money: reflux control for batch stills, quick check for feed pumps, heating coil for conical tank bottom—and many more. (p. 216)

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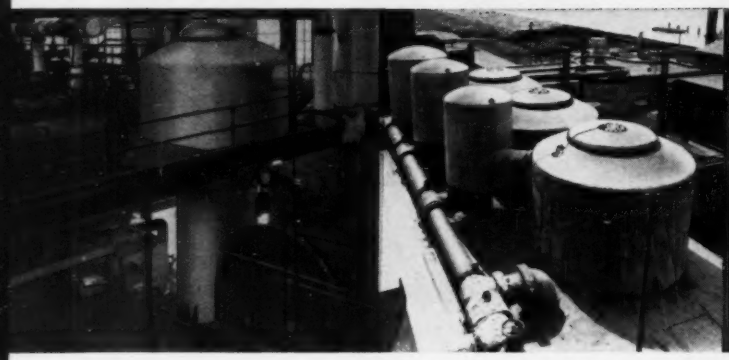
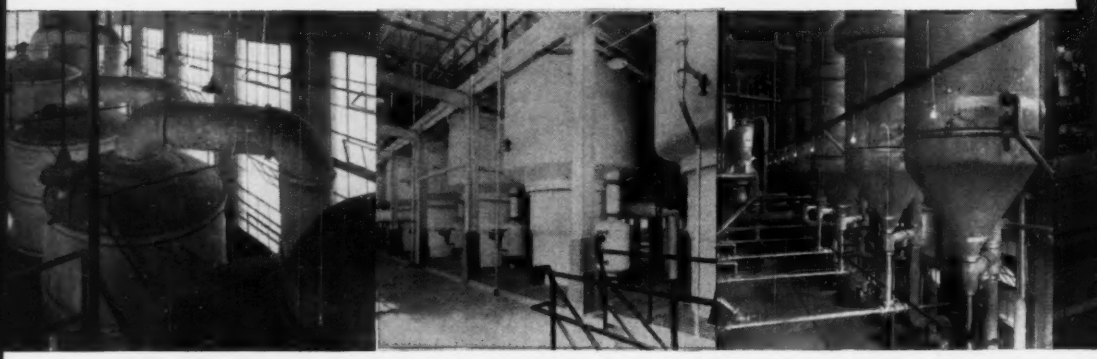


Long-tube, First-effect Pressure Evaporator operating on sugar juice, converting existing quadruple-effect to quintuple-effect.

Swenson Multiple-body, Quintuple-effect, Long-tube, vertical evaporator in a kraft paper mill.

A Swenson Spray Dryer used in a Distillery, handling distillers' solubles.

Every Spray Drying and Evaporating



Swenson Forced Circulation Evaporators used for concentration of viscous, salting and scaling liquors.

Swenson Quintuple-effect Evaporator used in the processing of beet sugar.

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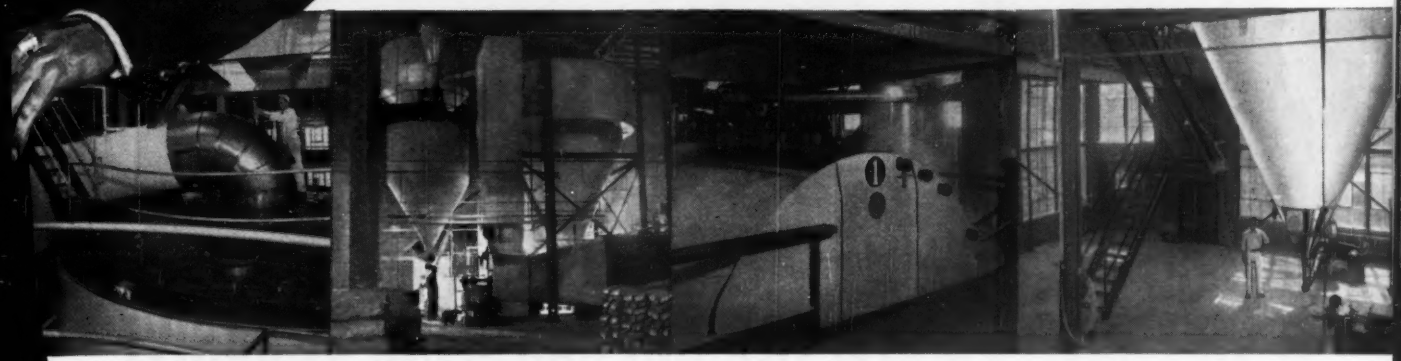

A Swenson Spray Dryer in operation at a large whole milk drying plant.

A gas-heated Swenson Spray Dryer in operation at a chemical processing plant.

Swenson also engineers washers for the pulp industry . . . shown is a single-drum, two-stage washer.

A Swenson Spray Dryer installation used in the production of starch products.

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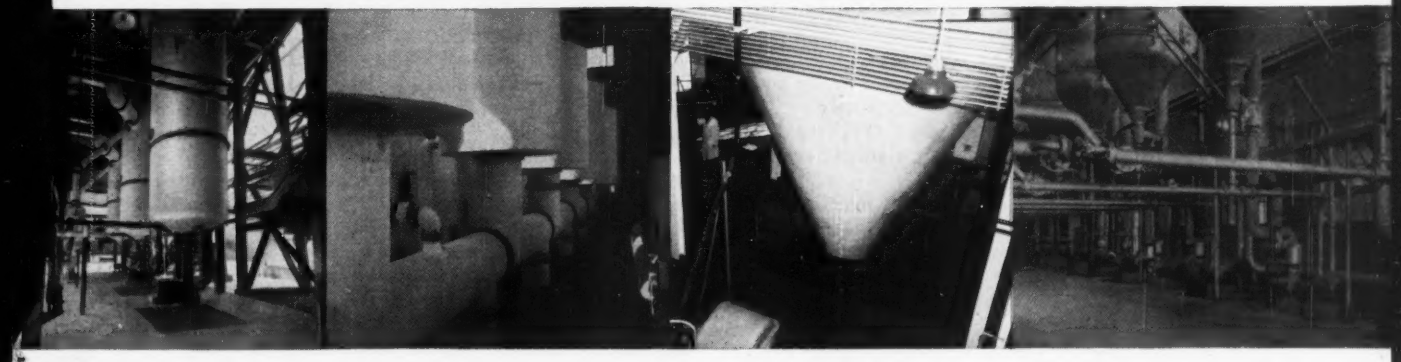

Swenson Multiple-effect, Long tube, Vertical Evaporator handling black liquor in a paper mill.

Catchalls and cutout vapor piping for a large Swenson Long-tube, Vertical Evaporator installation.

Lower section of Spray Dryer Chamber in which distillers' dried solubles are produced.

Swenson Multiple-effect, Quintuple-effect, Long-tube, Vertical Evaporator used for kraft mill black liquor.

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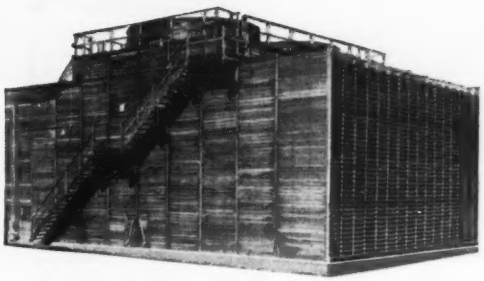

of arriving at proof of the performance your tower is delivering, the manufacturer will be glad to assist in verifying the integrity of his product. He will welcome the opportunity to provide the necessary technical assistance that will enable you to conduct conclusive tests.

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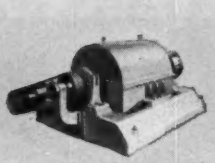

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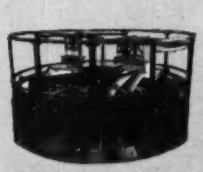

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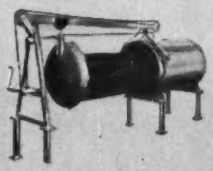

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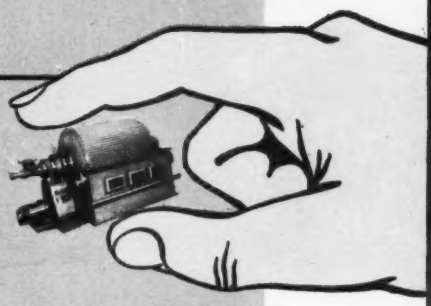

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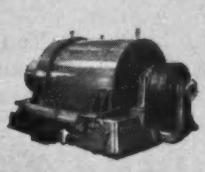

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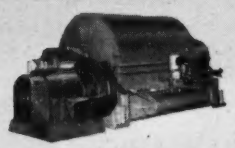

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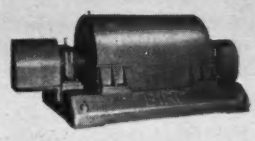

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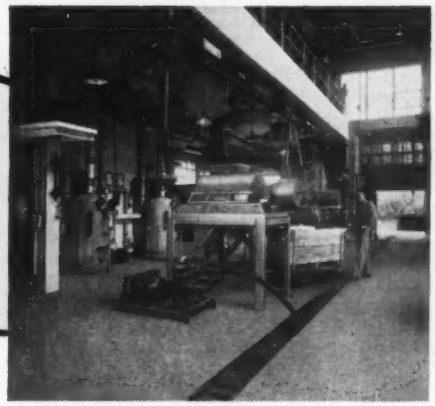

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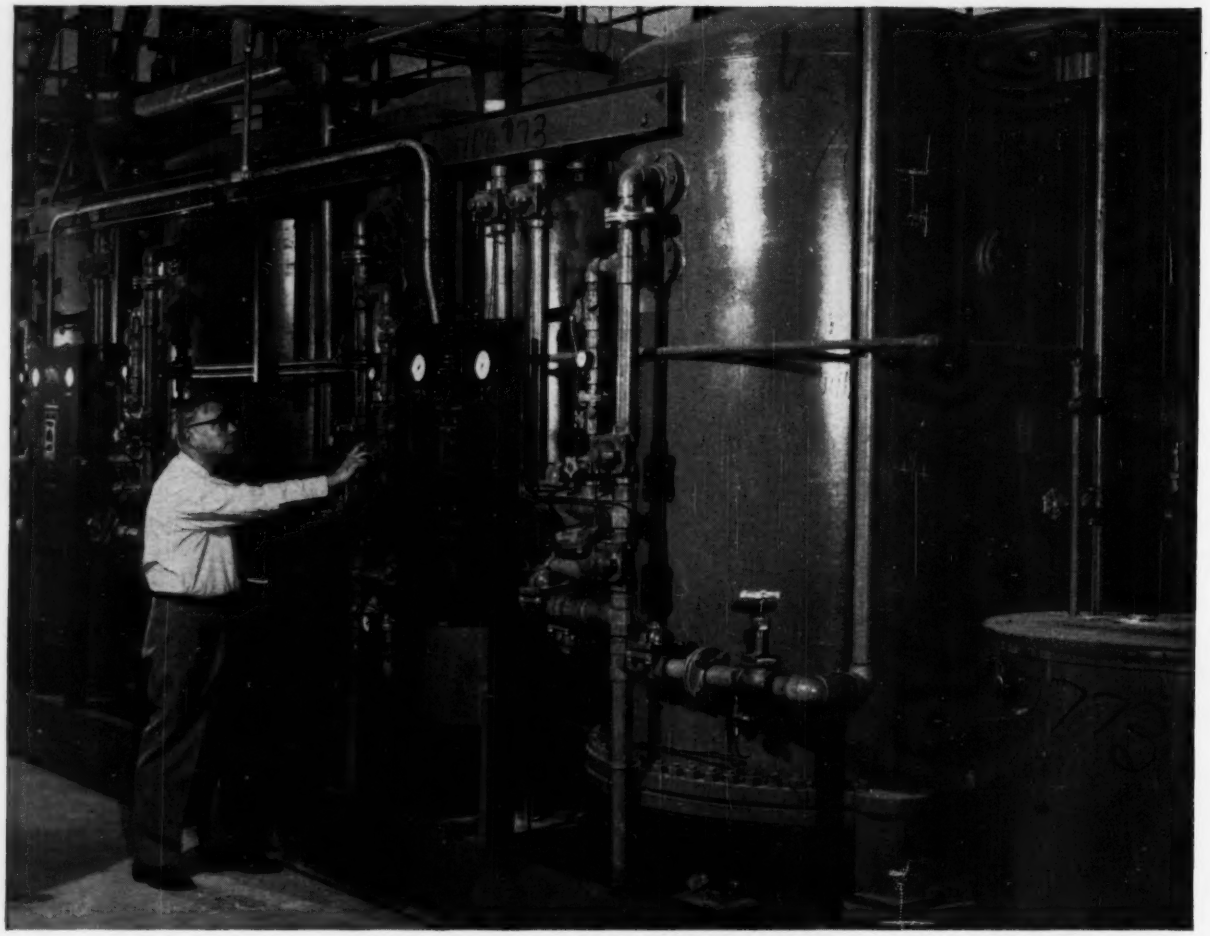

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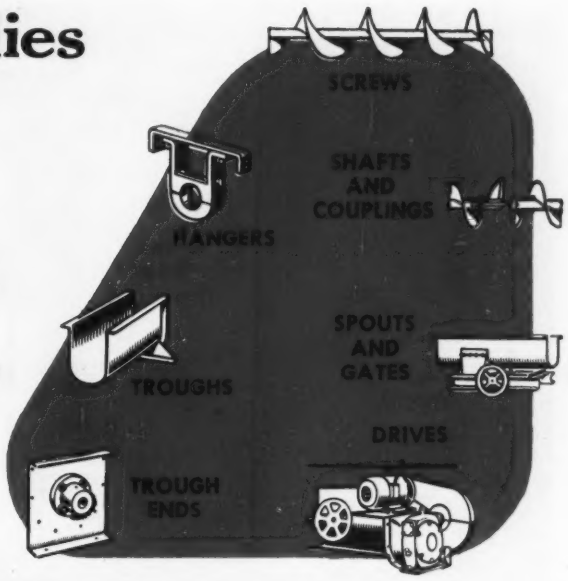

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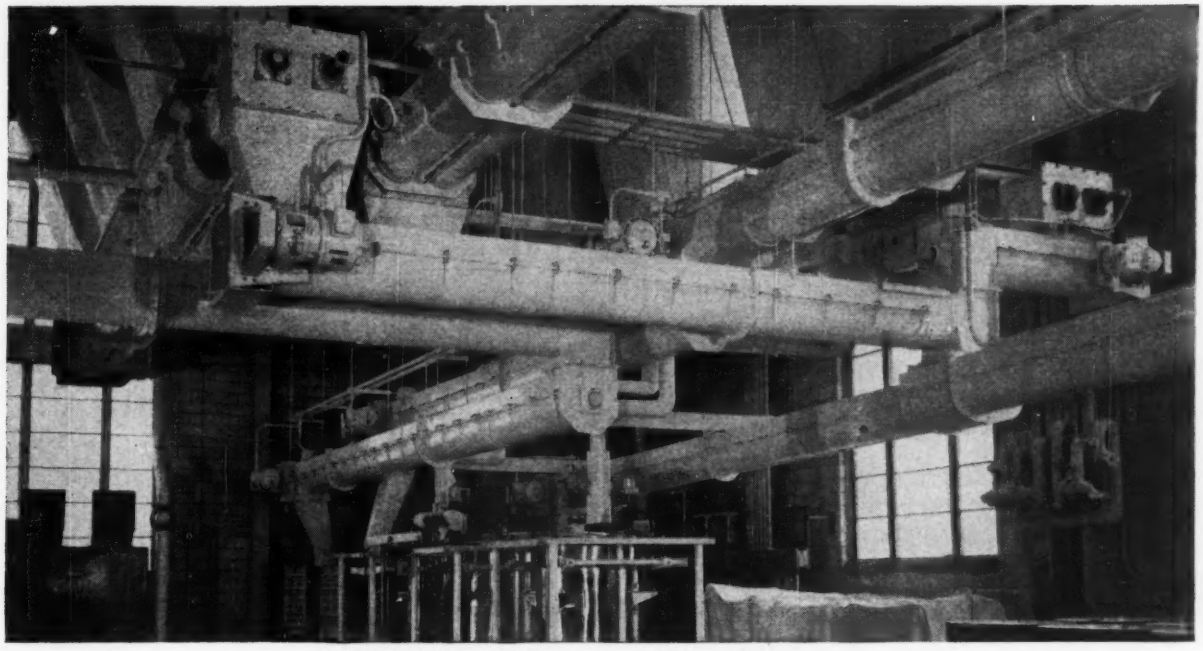
EASY ERECTION is achieved because of pre-fitting, match marking, close-tolerance manufacturing and Link-Belt drawings. Link-Belt will handle erection if you wish.

SATISFACTORY PERFORMANCE is assured when you rely on Link-Belt as a single contract source for your complete system. We will accept full responsibility for placing it in operating readiness.



At Midwest bakery, Link-Belt twin screw feeders and screw conveyors provide sanitary handling of sugar and flour to bins and sifters.

Extensive engineering experience has provided Link-Belt with standard solutions to specialized screw conveying requirements. In addition, local availability of Link-Belt engineering service and quality components assures prompt, efficient action. That's why—whether you plan a complete new system or improvement of present arrangements—a call to your nearest Link-Belt office is a sure step to lower handling costs.

LINK-BELT

SCREW CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,912

BRONZE · MONEL · ALUMINUM · STAINLESS STEEL

KAMLOK quick couplers

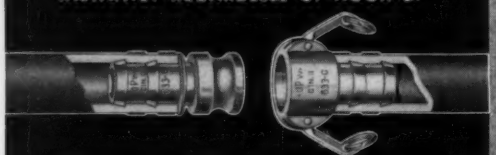
The Fastest, Surest Coupling Known

INDUSTRIAL HOSE LINES

TANK TRUCK FUEL DELIVERY MARINE SERVICE

Make field repairs quickly with this simple attachment of hose to KAMLOK shank type adaptor and coupler by using hose clamps. Leak-proof, light weight, easy to handle.

ALL KAMLOKS COUPLE AND UNCOUPLE INSTANTLY REGARDLESS OF HOOK-UP



KAMLOK'S POSITIVE SEAL ALL ALONG THE LINE ASSURES GREATER SAFETY IN HANDLING ALL TYPES OF LIQUIDS. Excellent hose has been condemned too often because of inferior couplings. To eliminate twisting, kinking, and straining, to add extra life and endurance to your hose use a good coupler . . . use KAMLOKS. Available in any combination to meet coupling requirements in sizes from ¾" to 4" inclusive. Sizes ¾" through 4" of special hard wear-resistant bronze and OPALUMIN*. 1" through 4" of monel. 1" and 2" (633A and 633B only) of stainless steel.

*OPW' bi-tensile aluminum alloy.

OPW CORPORATION
2725 COLERAIN AVENUE
CINCINNATI 25, OHIO

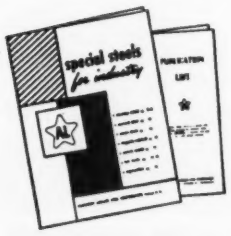
FREE BULLETIN F-10 HIGHLIGHTS IN DETAIL KAMLOK's QUICK, TIGHT SEAL.

Dollars of ***FIRST COST*** *aren't so big . . . if they're the* ***LAST COST***

First cost isn't everything! What really counts in most cases is not how much a thing costs when new, but how long it lasts; how *little* it actually costs when reckoned in terms of extra years of service.

That is where AL Stainless jumps to the head of the class. Stainless steel is a package of built-in advantages you just can't match anywhere else. No other commercial material is at once as hard, strong and lastingly beautiful — as resistant to heat, wear and corrosion — as easy and inexpensive to clean and maintain.

To top it off, AL Stainless is easy to fabricate, and we produce it in every shape or form a fabricator may require. Check up on its money-making possibilities for *you*, either in your products or your equipment, *and let us help!* ● ***Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.***



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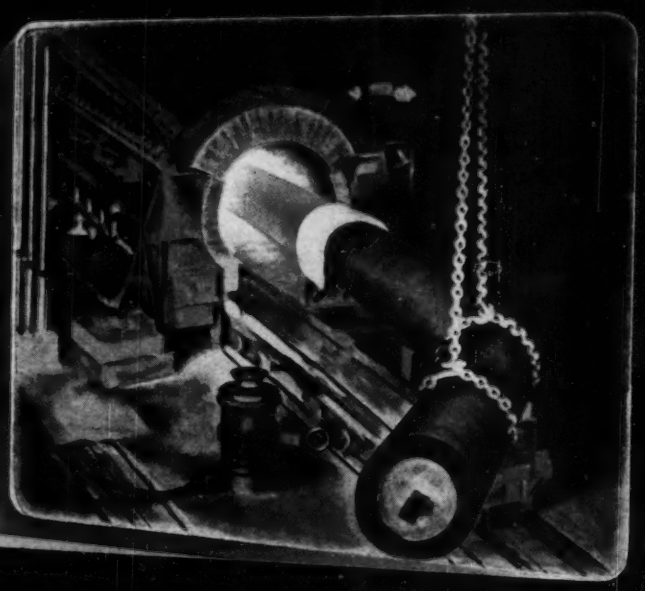


Bending

Stress Relieving

Automatic Welding

Ultrasonic Testing

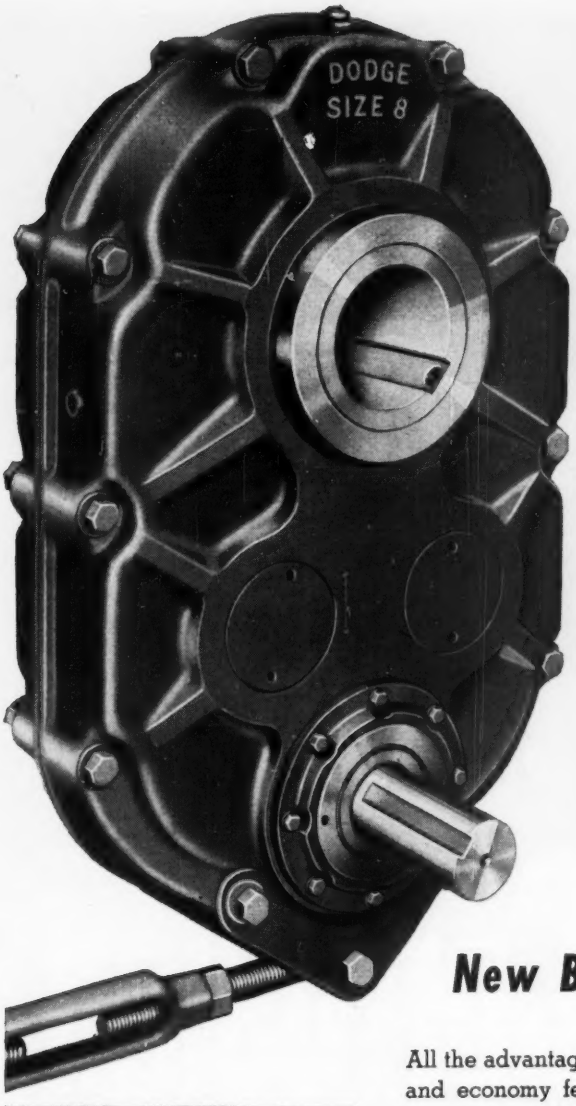
"PREFABRICATED PIPING by GRINNELL"

A 16mm. sound motion picture, in full color. Provides an educational close-up of latest techniques in the shop fabrication of piping. Available for showing without cost.

"Prefabricated Piping by Grinnell" is a fascinating and factual film. Produced by the 100-year old Grinnell Company, it sheds new light on the complex subject of prefabrication of piping . . . answers with complete authority many of the questions dealing with shop vs. field fabrication.

Now you can see for yourself how the experts bend 20-inch pipe, with walls four inches thick; how pipe is sand-packed to prevent collapse in bending; how alloy pipe is pre-heated to preserve its special characteristics; how to stress-relieve after bending or welding; how to cold bend pipe; extrude branch outlets; perform automatic welding. You can look over the shoulders of the experts . . . during radiographic inspection, hydrostatic testing, and photomicrographic examination.

There is no charge for this film. Engineering societies and engineering departments that desire to show this picture should address their local Grinnell Supply Sales Office, or Publicity Department, Grinnell Company, Inc., 291 West Exchange St., Providence, R. I. Requests will receive prompt attention.



NOW!

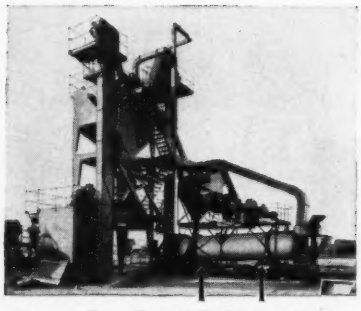
60 H.P. DODGE TORQUE-ARM SPEED REDUCER

New Big Size! New Big Savings!

All the advantages of shaft-mounting . . . all the proven performance and economy features of Dodge Torque-Arm Speed Reducers . . . are now available for your *big* jobs. The husky new size No. 8, in the double reduction series, has a capacity of 60 hp at 100 rpm, AGMA rating, and can be mounted on shafts up to 5-inch diameter.

The new No. 8 has all the inherent advantages of the Dodge Torque-Arm line. No foundation, no flexible couplings, no sliding base required—and there are no lining up difficulties. It is mounted directly on the shaft. The torque-arm, fastened to any fixed object, anchors the reducer. The unit is driven through any V-belt drive. Stock Taper-Lock Sheaves permit any speed ratio desired.

Another new member of the Torque-Arm line is the single reduction No. 11 (1.3 hp at 100 rpm, AGMA rating). Torque-Arm Reducers are now supplied, in both single and double reduction series, with capacities from 1 to 60 hp, output speeds from 12 to 365 rpm. For details write for special Bulletin.

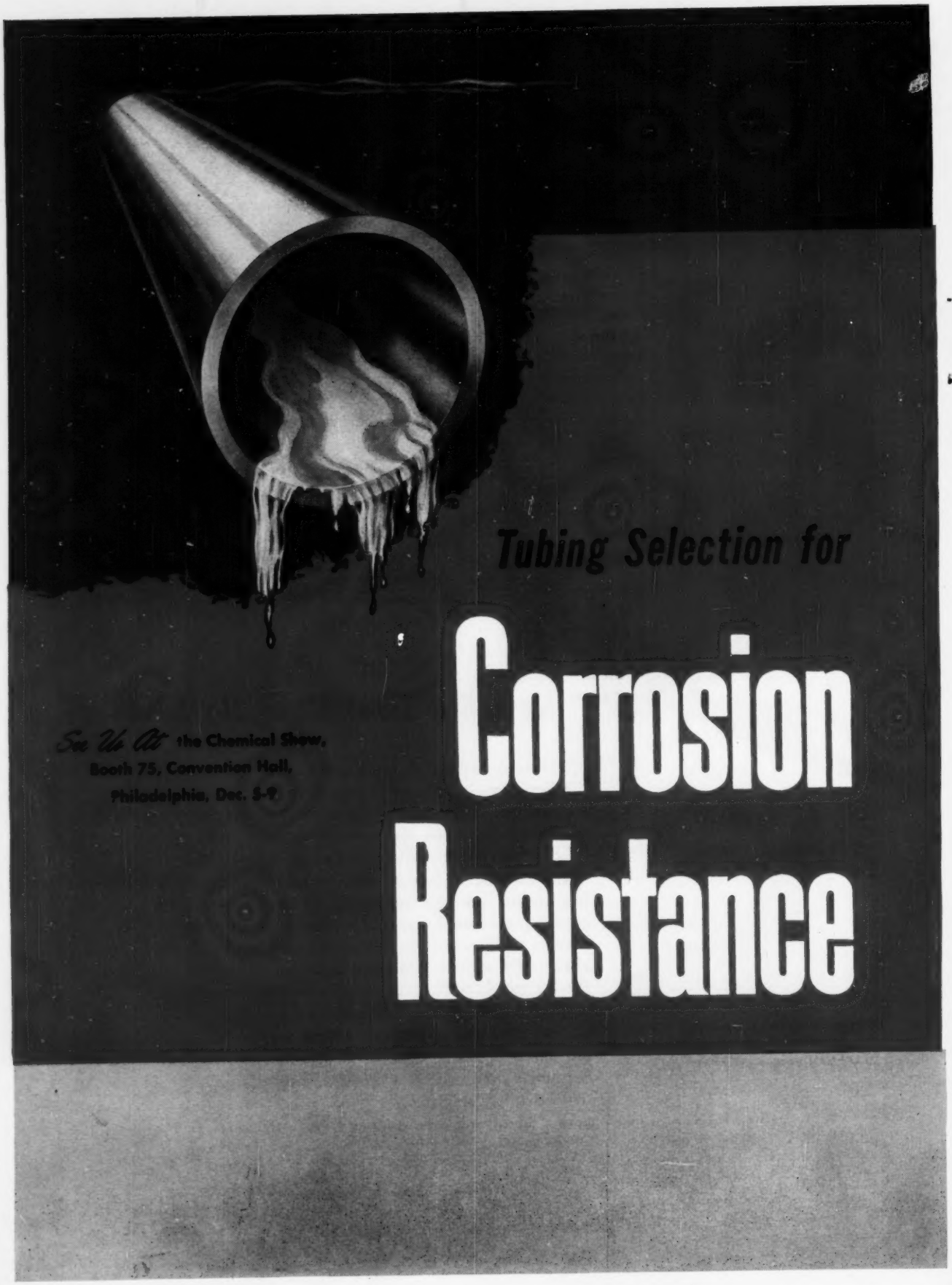


Torque-Arm Speed Reducers driving the trunnions rotating an asphalt kiln.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone directory, or write us.

DODGE MANUFACTURING CORPORATION, 200 Union St., Mishawaka, Ind.

DODGE
of Mishawaka, Ind.


Tubing Selection for
Corrosion Resistance
See Us At the Chemical Show,
Booth 75, Convention Hall,
Philadelphia, Dec. 5-9

Because of the almost endless combination of service conditions to which tubing and pipe can be subjected, selecting the right analysis for a particular application is no simple matter. For instance, there are many complications in the consideration of the proper choice of materials for corrosion resistance.

As an example, since chromium and nickel provide corrosion-resistance in stainless steel, it should follow that 18-8, 18-8 Cb, 18-8 Cb Ta, 18-8 ELC and 18-8 Ti, having similar chromium and nickel contents, should have similar corrosion resisting qualities. Exposure in certain types of service, however, may prove otherwise. If tubing of this group is field-welded without subsequent heat treatment, or operated intermittently at high temperature, the degree of corrosion resistance will vary. The 18-8 grade may lose its corrosion-resistant qualities while the others, under similar exposure conditions, keep theirs. The reason for this is found in the slight differences in their chemistries—5 parts in 10,000 in carbon content, or the addition of 5 to 7 parts in 1,000 of columbium, columbium-tantalum, or titanium.

While the 18-8 steels serve admirably in evaporators, heat exchangers, condensers and for fractionating gases at high temperatures, each application must be governed by the special factors present. The qualities of corrosion resistance are never general—they are always special and must be considered by specialists.

It takes an expert to specify the right tubing or pipe for any application, and there is no substitute for the kind of expert attention and experience you'll find at B&W. To get the greatest benefit from B&W's long experience in matching tubes to jobs, call on Mr. Tubes, your nearby B&W Tube Representative. He has helped others, as he can help you, make tubing selection *surer*.

TA-5045P

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
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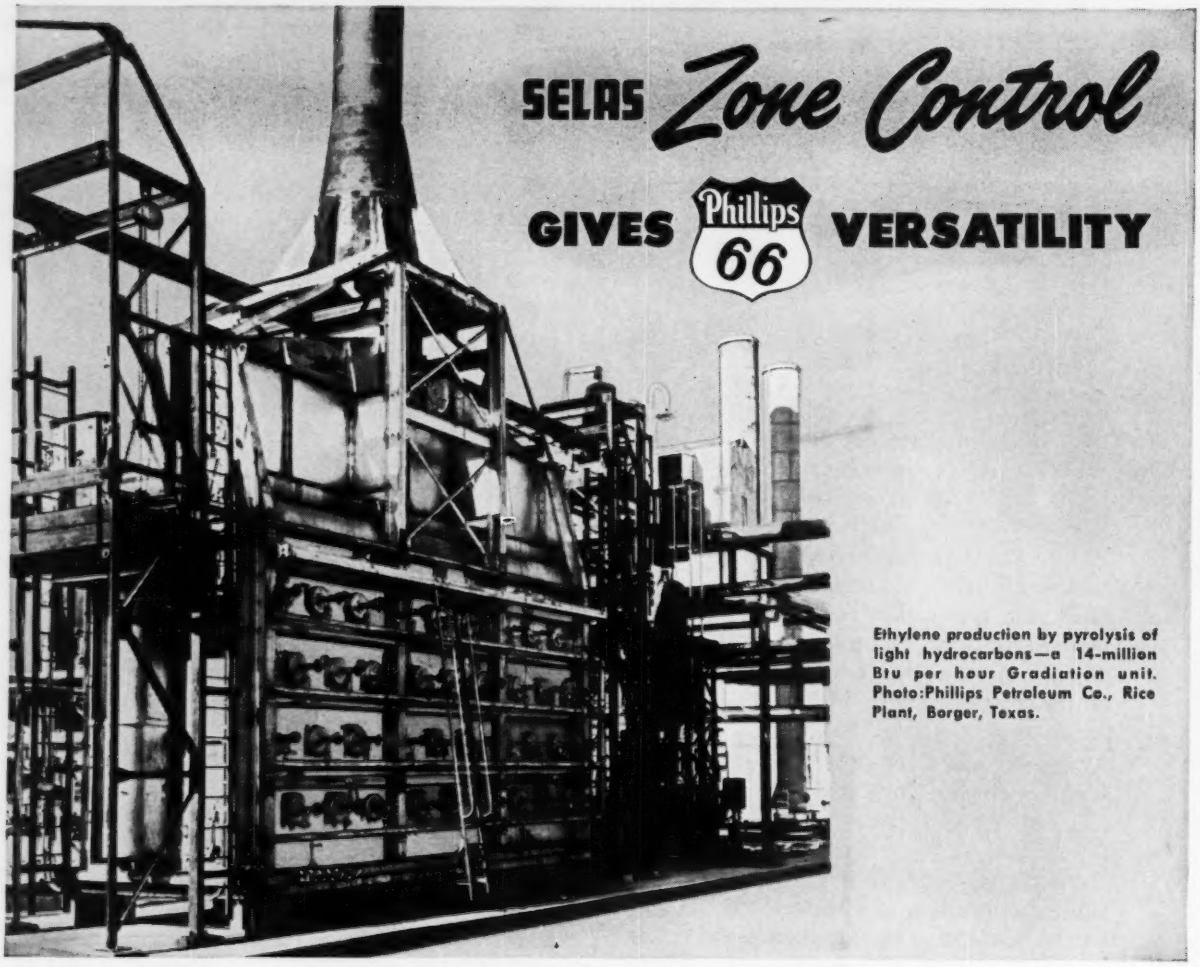

Ethylene production by pyrolysis of light hydrocarbons—a 14-million Btu per hour Gradiation unit. Photo:Phillips Petroleum Co., Rice Plant, Borger, Texas.

IN ETHYLENE PRODUCTION

Maximum product yield for any given feed stock . . . yet capable of handling extreme variations in feed stock . . . these are the outstanding features of Selas Zone Control in the production of ethylene at Phillips Petroleum Company.

Butane, propane or ethane are processed with equal ease at optimum conditions . . . through the same Selas Gradiation furnace . . . with exceptionally long runs. Average on-stream periods in excess of 60 days, at conversions of 65% ethane are obtained.

Other benefits of Selas Zone Control . . . whether your petroleum refining, petrochemical or chemical processing operations involve critical pyrolysis reactions, controlled catalytic reactions in packed tubes or high temperature preheating . . . are as follows:

- Uniform peripheral heat distribution around the tubes assures elimination of local overheating . . . minimized material degradation at the tube wall . . . greater tube life.
- Zones of controllable heat input produce the desired time-temperature curve . . . permit most effective use of the surface provided.
- Controlled combustion means no external oxidation of the tubes . . . no lag in response to controller demand.

Send for informative bulletin "Gradiation Heating for Petroleum and Chemical Processing" and article reprint, "Try the Gradiation Heater for Economical Ethylene Production."

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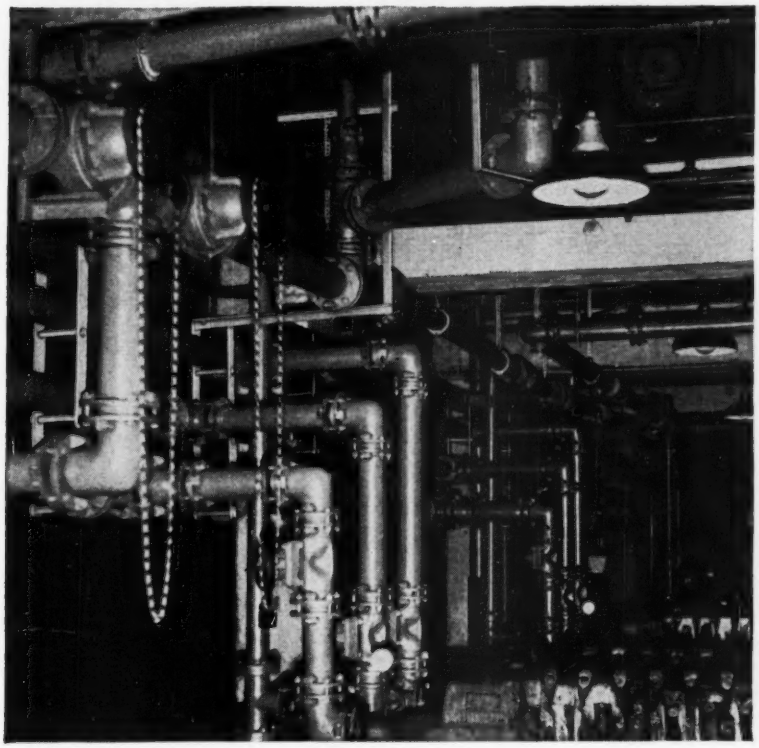
FLUID PROCESSING

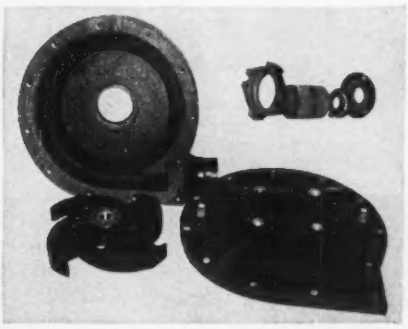
WHERE HAVEG EQUIPMENT IS INSTALLED

TRADE MARK REG. U. S. PAT. OFF.

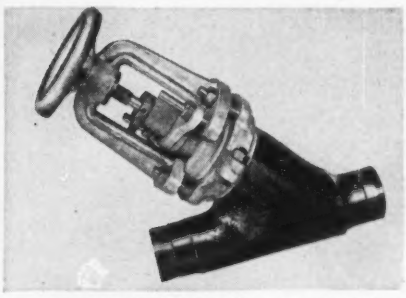
PIPE • DUCT • FITTINGS • VALVES • PUMPS



A typical large installation of Haveg pipe, valves and fittings showing simple method of support required. Haveg pipe is unaffected by thermal shock, seldom requires insulation.



These Haveg parts are used in pumps for hot (104°F.) 30% Hydrochloric acid, Typical record: 33 months without replacing a single part. Many users report even longer life.



Escape potential valve troubles by buying Haveg y-valves and diaphragm valves which are smooth-molded, exactingly machined, tested in the Haveg factory. Haveg works with you on special designs!

Processing Corrosion has been Controlled!

Where liquids get hot and corrosive, it pays to consider all the facts about Haveg piping systems. Haveg has all the major ingredients for good chemical piping. Strength. Durability. Light weight. Outstanding resistance to corrosion and thermal shock.

It withstands rapid temperature changes and enables you to go into a high range of process temperatures with complete safety and a proven history of reliable performance. Haveg piping resists corrosion of practically all acids (except oxidizing acids) and lasts for years without repairs or maintenance.

Haveg *piping* is molded in diameters of ½" up and comes in lengths to 10'. It can be cut and fitted on the job (a new Haveg tool makes this even simpler—ask your Haveg engineer for details). For handling corrosive gases or fumes, Haveg *duct* is made in cylindrical or rectangular shape with lighter walls. Fume hoods, bifurcators, fan housings, fittings, all are made from Haveg and give complete containment and control of corrosives.

It's a long story telling all about Haveg, the moldable, thermosetting plastic material made of acid-digested asbestos and synthetic resins. Haveg is both a material and a service . . . it comes from America's first molders of corrosion-resistant plastic equipment. It can be as big as a 200' stack, as small as a miniature pump part. Call the experienced sales engineer listed. Write for the 64-page illustrated Bulletin F-6 which contains size and chemical resistance charts, design specifications. Remember, Haveg is a logical, proven answer to your design problems in handling hot, corrosive liquids; in fact, in all equipment that must control processing corrosion.

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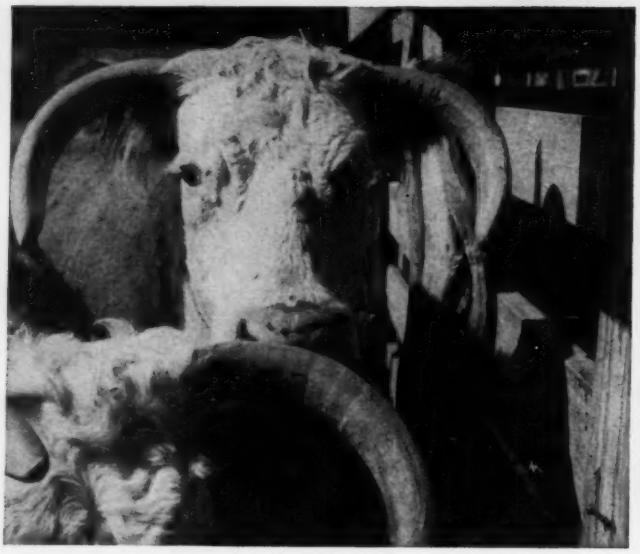
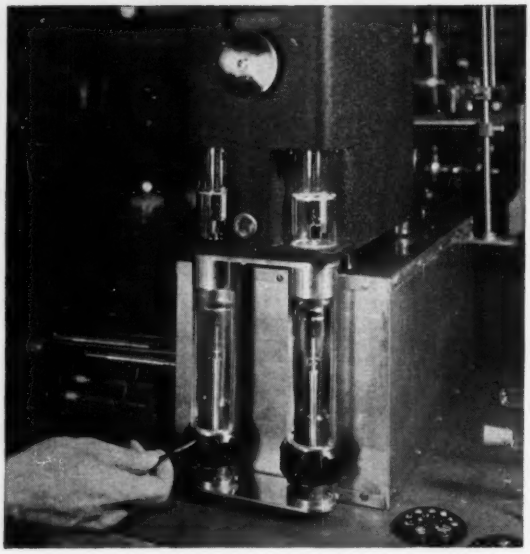
Life ...on the Chemical Newsfront

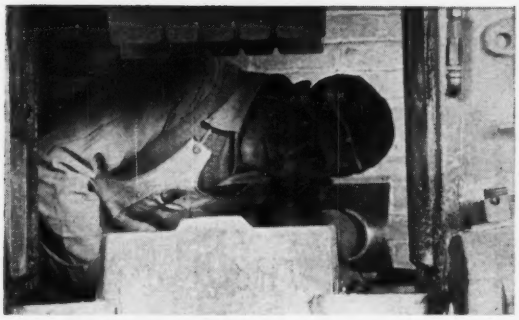


MORE MEAT, FINER HIDES and better wool come from livestock free of debilitating parasites. Highly efficient control of animal parasites has been secured with a diphenylamine derivative, phenothiazine, the most effective vermifuge known. Diphenylamine, recently added to Cyanamid's line of intermediates, is the basic ingredient in the synthesis of this important veterinary drug. However, uses for diphenylamine do not stop here. It is used in the manufacture of rubber antioxidants, smokeless powder, and dyes for paper and textiles.
(Organic Chemicals Division)



FIRST GARNER HEAVY-DUTY QUARTZ FIBER MICROBALANCE, produced in collaboration with Cyanamid's microchemical staff, permits 100 times more load than previously, but retains accuracy to one-billionth gram. Extreme accuracy, and efficient chemical and process controls in making AERO* Metallic Stearates assure Cyanamid's customers consistent products with uniform physical properties. Typical Analysis Sheets on AERO Metallic Stearates are available.
(Industrial Chemicals Division, Department B)

NOW PAPER IS REPLACING WOOD for sealing in bulk shipments of grain, malt and chemicals. Standard practice since the 1880's had been to nail up boxcar doorways with expensive laminated wood "grain-doors." A. J. Gerrard & Company of Illinois hit upon the idea of a lightweight, inexpensive barricade made of glass fiber reinforced paper. The idea was sound, but experience showed that still greater strength, particularly wet strength, was needed. So Gerrard tried MELOSTRENGTH* Paper. Results were spectacular. Dry strength increased 30%, wet strength shot up 400%, making these barricades eminently practical for withstanding the thrust of heavy loads, even if soaked by seeping rain. Required to stand up under 9,000 pounds pressure, the barricades now resist 36,000 pound loads. Lightweight MELOSTRENGTH Paper barricades are easy to handle and install, weighing only a fraction of the wood they replace. Because of their low cost, they are expendable. With the high wet and dry strength imparted by MELOSTRENGTH® Resin, paper is finding many such new uses. **(Industrial Chemicals Division, Department B)** *Trade-mark



Two-part die placed in press—ready to use without time-consuming scraping and finishing.

"SETTING-UP" EXERCISE

New amines mean faster cure for epoxies

New time and labor savers are now cast from epoxy resins. Epoxy dies, like the drop-hammer die illustrated, can often be made in hours, instead of the usual days to weeks of work required by previous materials. Dies are made by Teicher Manufacturing Co., Flushing, N. Y., using resins supplied by the Marblette Corp., Long Island City, N. Y. Rapid curing at moderate baking temperatures, or even at room temperature, is secured through proper selection of casting material and curing agent.

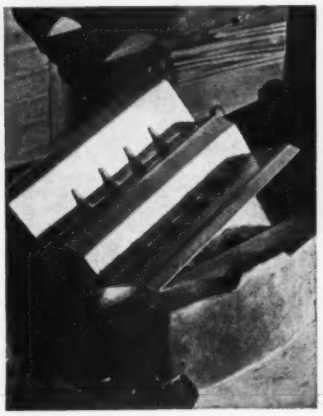
For such casting applications, and for adhesives and coatings, Cyanamid has developed four new amines as curing agents: Dimethylaminopropylamine, Diethylaminopropylamine, Dibutylaminopropylamine, and Iminobispropylamine. Fastest cure is obtained with Dimethylaminopropylamine and longer pot life with those having higher substituents. These amines also are valuable intermediates for products such as surface active agents, pharmaceuticals and dyestuffs.

(New Product Development Department)

Top half or punch of drop-hammer die is poured. Epoxy resin with curing agent "sets up" in a few hours.

Blank of aluminum sheet is inserted between punch and die.

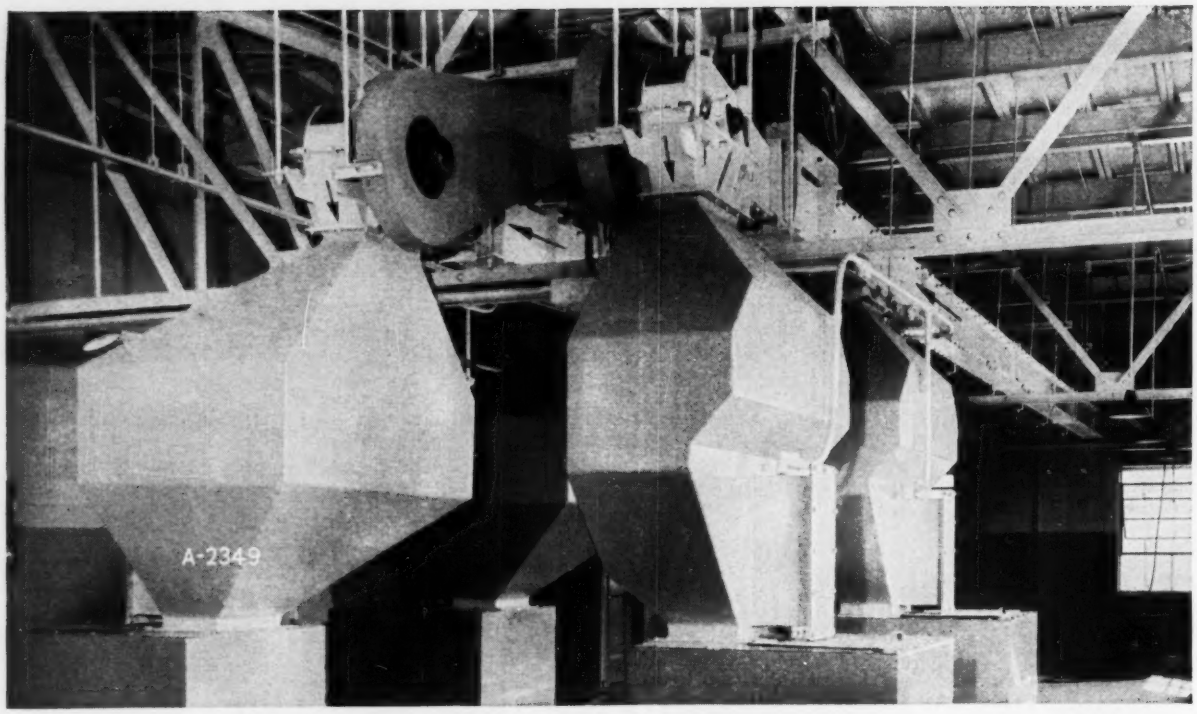
Stamped part after being formed by plastic die.



AMERICAN Cyanamid COMPANY

30 Rockefeller Plaza, New York 20, N. Y.

Additional information may be obtained regarding these products by writing on your business letterhead to the Division of American Cyanamid Company, 30 Rockefeller Plaza, New York 20, N. Y., indicated in the captions.



Sealed Conveying Pays Off Here

Push-Button S-A REDLER SYSTEM Moves Chemicals In Dust-Free, Moisture-Protected Flow

"Move alum and lime for water treatment to an overhead storage system — do it economically without dusting — and protect the easily hydrated materials from moisture." This handling problem at the Radford Arsenal, Radford, Virginia, was completely solved with the installation of an S-A Redler Conveyor-Elevator system.

Casings of these compact conveyors are completely sealed — even the connections between units are gasketed. Dust can't get out — moisture can't get in.

REDLERS bring other important advantages vital to automatic handling. They are self-feeding, will not jam when choke-fed and are exceptionally compact. They are self-cleaning, insuring product purity on every run. Power requirements are low and REDLERS, because of their minimum weight, cut support requirements. All this adds up to push-button conveying at low cost per ton for Radford Arsenal.

If you have the problem of moving anything from coal to cornstarch — without dust or product contamination — REDLERS are an economical answer. For full details, write for Catalog No. 140.

AT RADFORD ARSENAL, REDLER system is push-button controlled. Pressing a single button opens motor-operated gates under feed hoppers and starts REDLER Conveyor-Elevators. Chemicals are carried 50-ft. vertically and 50-ft. horizontally to surge bins. Lime moves at 2-tons per hour, alum at 3-tons per hour. S-A Tellevel control closes feed gates when bins are full. Conveyors run until thoroughly cleaned out. Then button re-sets.

Cross-section through standard REDLER unit. Skeleton flights attached to chain links move material in a solid column, minimizing dust formation and degradation.

STEPHENS-ADAMSON MFG. CO.

3 Ridgeway Avenue, Aurora, Illinois • Los Angeles, Calif. • Belleville, Ontario

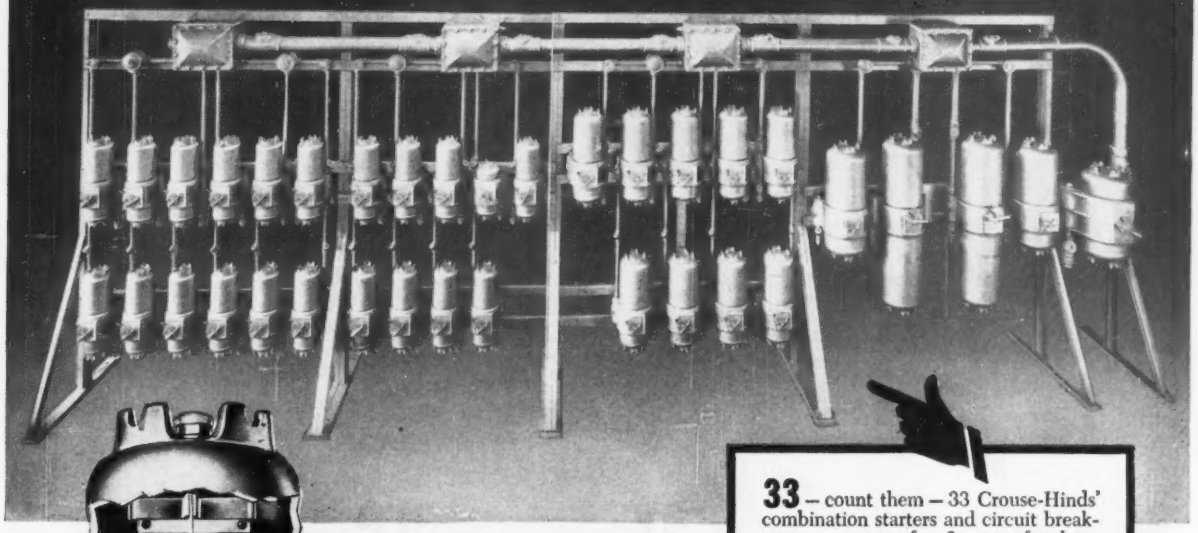
Engineering Division
Specialists in the design and manufacture of all types of bulk materials conveying systems

Standard Products Division
A complete line of conveyor accessories including centrifugal loaders — car pullers — bin level controls — etc.

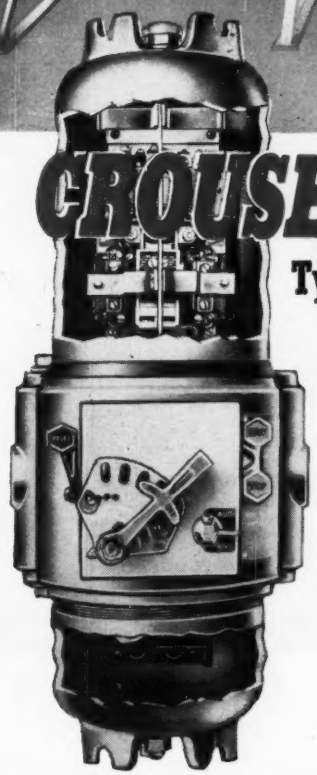
Sealmaster Division
A complete line of industrial ball bearing units available in both standard and special housings.

SINCE 1901 S-A STEPHENS ADAMSON MFG. CO.

Need more motor controls BUT... haven't enough room?



33 – count them – 33 Crouse-Hinds' combination starters and circuit breakers . . . space for 2 more for later installation . . . plus 2 circuit breakers —all in 28' x 10' of space! Conventional single-tiered installation would have required 20 ft.-longer rack and 4 more junction boxes.



CROUSE-HINDS

Type EPC Explosion-Proof MOTOR STARTER and CIRCUIT BREAKER CONDULETS* take up less space!

As in the installation shown above, a given area will hold *more* Crouse-Hinds' motor controls than any other make. You save money on the construction of steel mounting racks – fill your needs without occupying additional premium floor space.

- Explosion-proof, dust-tight, weather-resistant.
- Light-weight cast aluminum for easy installation without lifting equipment.
- Flame-tight threaded joints throughout.
- Seven conduit entrances simplify installation.
- Built-in push button stations and built-in selector switch available.
- Starter sizes 0 to 5. Circuit breakers 50 to 600-amp. frame sizes.

Let Crouse-Hinds help you solve your space problems. Engineering assistance available without obligation.

*CONDULETS are made only by CROUSE-HINDS

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

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Crouse-Hinds Company of Canada Ltd. Toronto, Ont.

CONDULETS • FLOODLIGHTS • TRAFFIC SIGNALS • AIRPORT LIGHTING

Trent– Pioneer in Welded Tubing

Since it was formed nearly 15 years ago, the Trent Tube Company has led the welded tube industry in new developments to bring you better quality stainless pipe and tubing.

Trent was first, for example, to commercially produce welded tubing using a helium-gas shielded arc and nonconsumable electrode. This process, called TRENTWELD, was used exclusively by Trent for seven years, although today all welded stainless tubing is made by the inert-gas shielded method. The TRENTWELD process produces an exceptionally sound weld, free from gaseous inclusions and without contamination from extraneous metal. In fact the chemical and physical properties of TRENTWELD tubing are as good or better in the weld zone as in the body metal of the tube.

Recognizing that the uses for as-welded tubing were limited primarily to ornamental applications, Trent also led in developing and improving after-welding processing methods. Today Trent's cold working, annealing, pickling and passivating, testing, and inspection operations are unsurpassed in the welded tube industry.

Now, with Trent's new patented *Contour-Welding* process – another major and exclusively Trent development – you are assured of the highest quality stainless pipe and tubing available anywhere when you specify TRENTWELD.

Contour-Weld*

a major development in stainless pipe

Big news for stainless and high-alloy pipe and tubing users! It's Trent's brand-new, patented *Contour-Welding* process that brings you the true uniformity of welded pipe and tubing, *plus complete absence of weld bead or undercut. Contour-Welding* produces a pipe and tube so smooth, so uniform that the weld is practically imperceptible.

And it means improved physical properties . . . better finish . . . elimination of cavitation corrosion or erosion. Flared or flanged ends are smoother, too. In fact, by whatever test you choose, Trent's *Contour-Welded* pipe and tubing will outperform any other pipe or tubing.

Here's why — *Contour-Welding* makes use of all the best features of the original Trentweld process — uniform stainless or high-alloy strip . . . controlled inert-gas shielded arc welding . . . absence of any filler rod. But there's *one vital difference.* In *Contour-Welding* the weld is made at the bottom of the formed strip. Gravity works to pull down the molten weld metal until it perfectly matches the contour of the pipe.

Like most good ideas, *Contour-Welding* sounds simple. But until Trent redesigned and rebuilt their mills, no equipment had ever been made to allow continuous welding at the bottom of the pipe or tube.

Wider range of grades available — Improved physical and metallurgical properties afforded by *Contour-Welding* make it possible to produce welded pipe and tubing in grades and sizes not readily available before in acceptable quality. Now, for example, you can get *Contour-Welded* Hastelloy, Zirconium, Zircoloy, Titanium and 19-9-DL grades.

Try Trent's new *Contour-Welded* pipe or tubing for yourself. Whether it's for corrosion or heat resistance — pressure or mechanical applications, you'll find *Contour-Weld* best. Prove it. Ask for a sample, and give it any test you like. It's the quickest way to satisfy yourself that *Contour-Welded* pipe and tubing outperforms all others. And remember, it's made by Trent — tube mill specialists.

*Contour-Weld is the trade mark of the Trent Tube Co. for its process of welding pipe and tubing which is protected under U. S. Patent 2,716,692.

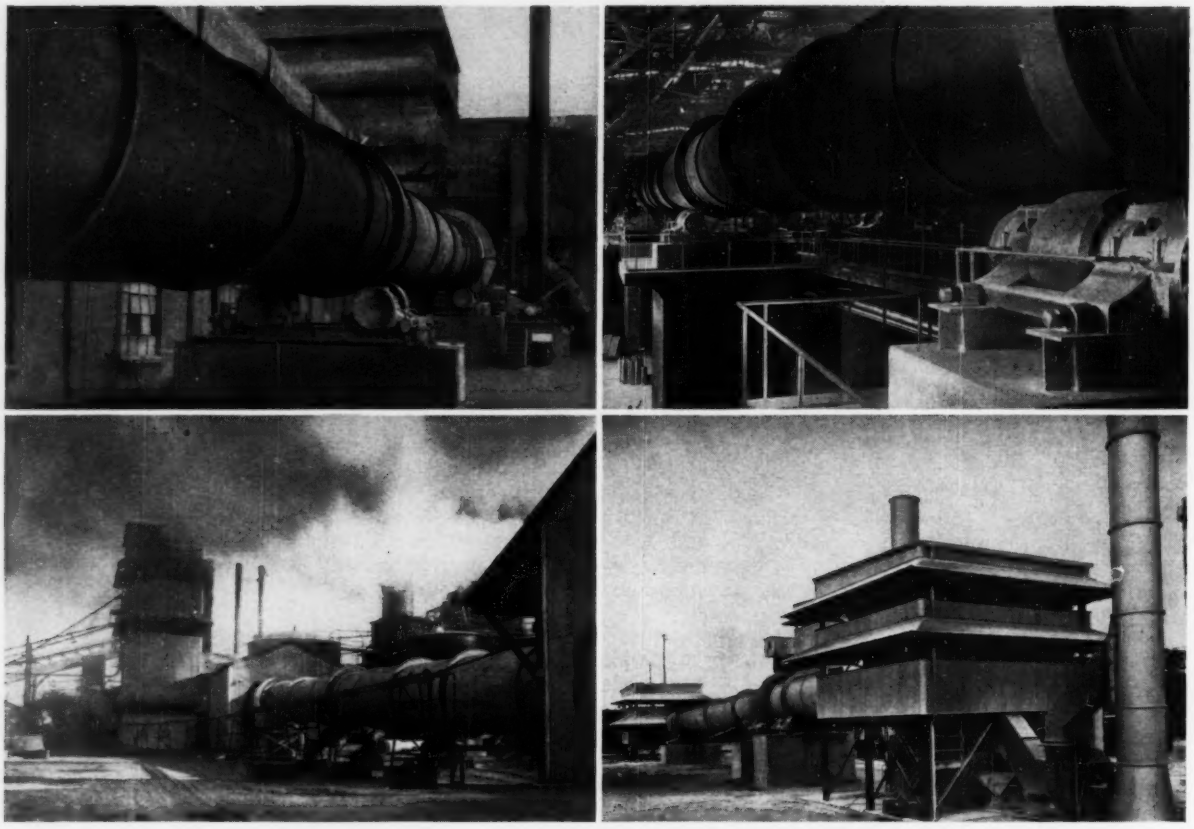
Why Trent's Exclusive *Contour-Weld* Process means smoother welds . . .

Here's the conventional way of welding pipe. Gravity pulls some of the molten metal down into the pipe to form a bead that is extremely difficult to remove by cold working. This is particularly troublesome in heavier gages. Cold working of the inside bead can lead to undercuts, focal points for erosive and corrosive attack. Cleaning is difficult.

Trent couldn't repeal gravity, so they put gravity to work. They flopped the pipe over, and made the weld at the bottom. Gravity still pulls the molten metal down — but, in doing so, it makes the weld contour correspond to the contour of the pipe itself. That's why there's no tell-tale bulge of weld metal on the critical inside pipe surface. And, even on the outside surface, the weld contour more closely approaches that of the parent metal than any other welded pipe.

TRENTWELD **STAINLESS STEEL TUBING**

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)



Traylor Rotary Kilns Save Thermo-Processing Dollars because they're built with the biggest background of engineering experience in the field

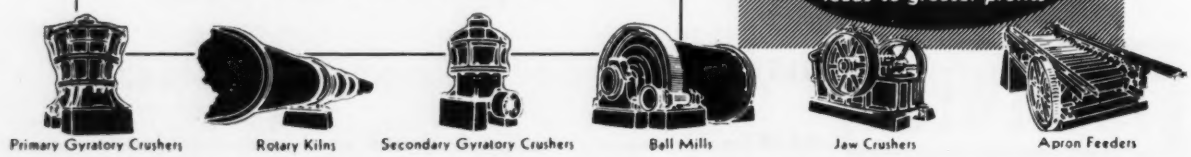
For over 40 years Traylor has been building Rotary Kilns for calcining, roasting and chloridizing, volatilizing, sintering and nodulizing. In the past 14 years alone, more than 150 Traylor Rotary Kilns have been built for processing some 21 different materials . . . an average of almost 1 kiln a month. With more than 33,000 feet of rotary kiln construction in this period, Traylor has the backlog of experience necessary to design a kiln for any thermo-processing operation.

In addition to the many recognized operating and maintenance economies offered by Traylor Rotary Kilns, many new thermo-processing problems have been solved through Traylor's accumulated knowledge of kiln construction.

"Traylor-Made" to fit each individual job, Traylor Rotary Kilns have been made in 12′ diameter, 450′ long. Bulletin #1115 gives complete description, illustrations and specifications. Send for your free copy today.

TRAYLOR ENGINEERING & MFG., CO.
791 MILL ST., ALLENTOWN, PA.
SALES OFFICES: New York • Chicago • San Francisco
Canadian Mfrs: Canadian Vickers, Ltd., Montreal, P.Q.

A Traylor leads to greater profits

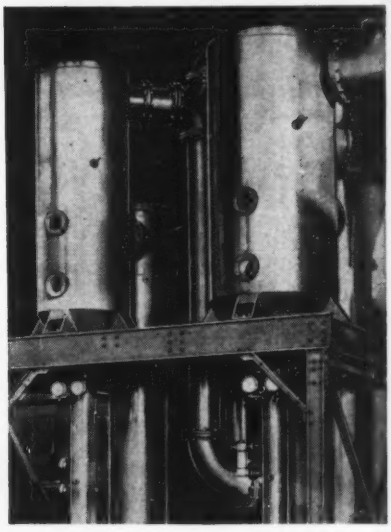


ECONOMY
High-alloy layer—usually 10% or 20% of total plate thickness—assures corrosion and abrasion resistance, long equipment life.

DESIGN FREEDOM
Integral bond allows design and fabrication of shapes to meet process and space needs.

STRUCTURAL STABILITY
Low-cost carbon steel backing provides necessary strength and rigidity.

Nickel-clad steel in this double effect evaporator guards against product contamination.



CLAD STEEL EQUIPMENT PERMITS

FULL DESIGN FREEDOM

For pressure, vacuum or cyclical service, economical clad steels give you maximum freedom of design in tanks and pressure vessels. Clad steels are readily worked by conventional fabricating tools and methods, can be formed to shapes that best suit space and process needs. Because of the integral bond between high-alloy cladding and the carbon steel backing plate, full gage consideration is permissible under the ASME Code. You're assured of extra-long service life, too, since openings can be cut and attachments welded to clad steel without harming this bond or allowing seepage.

By using clad steels, you get all the advantages of solid, high-alloy construction—protection from corrosion, abrasion and product contamination—with savings up to 50% in material costs. These and other benefits, like fast heat-up, easier cleaning and low maintenance, can be obtained from 16 cladding materials—various types of stainless, nickel, Inconel, Monel, copper.

These are supplied with a standard sodium hydride finish, or may be polished to help improve performance characteristics. When you're thinking of new tanks and vessels, qualified equipment builders can help your engineers and consultants take advantage of versatile Lukens' Clad Steels. We work closely with fabricators to help select the type most suited to your processing needs. To get more information, ask one of your equipment builders, or write Manager, Marketing Service, Lukens Steel Company, 749 Lukens Building, Coatesville, Pennsylvania.

LUKENS CLAD STEELS

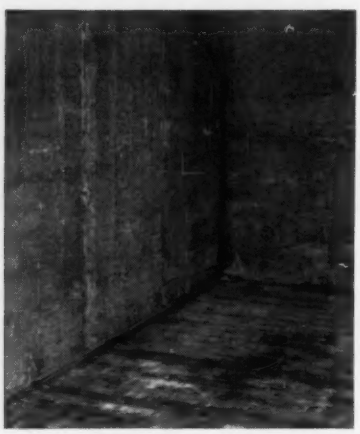
STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEEL PLATES AND HEADS AVAILABLE

for your information...

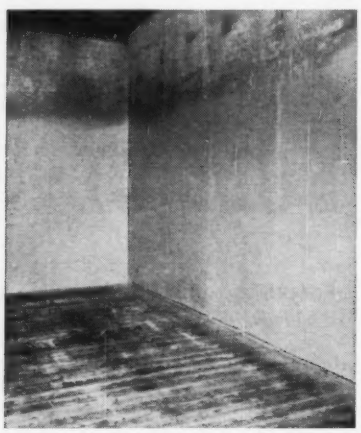
brief summaries of helpful product news

New, fast way to reline boxcars with reinforced plastics suggests many in-plant uses



In only 2 to 3 hours damaged boxcar lining (left) can be restored for many months of extra duty with a tough, protective coating of reinforced plastics.

Polyester resin, sprayed on lining with ordinary spray equipment. While coating is still wet, fiberglas cloth is applied, followed with another coating of resin.



Reinforced plastic coating can be cleaned with detergents, disinfectants, steam: can be applied in wide ranges of weather and temperature extremes.

One of the major contributors to the present boxcar shortage is the car that has lining in such poor condition that it must be torn out and replaced. This costly, time-consuming job can knock a car out of service for as many as 70 to 100 hours.

Relining time cut to only 2 to 3 hours

A new method of lining freight car interiors has been developed by an aggressive midwest manufacturer.† The process, employing two materials—a special polyester resin and a glass reinforcing cloth—has reduced the operation to only 2 to 3 hours, depending on surface to be covered . . . offers a quick solution to the car shortages experienced by most railroads.

How it's done

Complete or partial relining with reinforced plastics is applied as follows:

1. Using ordinary spray equipment, a basic coating of polyester resin is applied.
2. Glass cloth is applied to wet, tacky coating.
3. A second coat of polyester resin is applied over cloth and dries to a hard, rigid smooth finish.

Money, manpower savings

Two men can complete the application in about 2 hours. In experimental applications, maximum costs have averaged $150.00 per car including labor and material . . . a fraction of the cost of ripping out and installing wood lining.

Suggests many in-plant uses

The use of such rugged, reinforced plastic protective coatings is becoming a standard maintenance practice in many plants. Warehouse stall partitions and surfaces requiring resistance to moisture or abrasion activity, for example, are easily and economically surfaced in short order.

For more information on this process, check the coupon to the right and mail to Monsanto today.

Monsanto does not make polyester resins, but it does supply the plastics industry with its basic raw materials: phthalic and maleic anhydrides, fumaric and adipic acids, and styrene monomer.

†*Name on request.*

Pydraul F-9 wins UL listing; 2 new Pydraul grades developed

On May 31, 1955, Pydraul* F-9 became the world's first fire-resistant hydraulic fluid listed by Underwriters' Laboratories. From the Laboratories' Service Card: "The fire hazard of Pydraul is rated 2 to 3 in accordance with Underwriters' Laboratories, Inc.'s Standard of Classification in which ether rates 100, gasoline rates 90-100, alcohol (ethyl) rates 30-40 and paraffin oil rates 10-20."

For lubricity, stability and service life, Pydraul F-9 equals the performance of premium petroleum fluids. The Timken lubricant test shows Pydraul has a film strength of 17,500 psi, while ordinary petroleum-based fluids rate only 5000. The Almen wear tests using Pydraul showed only 2 mg. of metal lost in a 20-minute run. With petroleum oil, metal seized in one minute under the same load. Pydraul F-9 is also re-usable, noncorrosive, stable and economical.

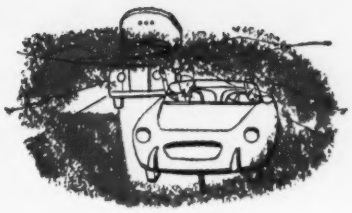
Two new grades of Pydraul are now available:

PYDRAUL 600 is a fire-resistant hydraulic fluid which delivers maximum performance where a high-viscosity fluid is required.

Designed originally for use in die-casting machines and presses, Pydraul 600 has also gained wide acceptance in other applications such as a lubricant for air compressors.

PYDRAUL 150 is designed for use in equipment where a low-viscosity fluid or low-temperature operation is required. Pydraul 150 is commonly used in regulating equipment throughout the steel industry, particularly in out-of-doors installations.

For more information on Pydraul hydraulic fluids, check the coupon.



New Multipurpose Additive Increases Lubricant Efficiency

A true multipurpose additive which sets a new standard of gear lubricant performance has been developed by Monsanto.

Called Santopoid* 44, the additive combines in one product the best performance characteristics of several separate additives which are effective only in limited applications. Lubricants compounded with Santopoid 44 provide complete passenger car hypoid protection under the most severe road test and laboratory conditions . . . not only in the SAE 90 grade but in the SAE 80 grade as well.

Field experience proves Santopoid 44 also gives better heavy-duty truck and bus gear protection without compromising superior high-speed performance. Heavy equipment is protected even when performing the most severe off-highway service.

For information, please mail coupon.

Versatility of Dibutyl Fumarate described in new technical bulletin

A new technical bulletin is now available on versatile dibutyl fumarate. A reactive resin and chemical intermediate, dibutyl fumarate forms copolymers with various monomers under adjusted reaction conditions to produce polymers ranging from brittle resins to soft; internally plasticized materials.

Copolymers of dibutyl fumarate with vinyl acetate, vinyl chloride, acrylates and styrene are used in formulating surface coatings, free films, permanently tacky adhesives, fibers, synthetic lubricants and additive agents for oils. And as a chemical intermediate, it yields substituted succinates readily with the addition of halogens, aldehydes, thiols and similar compounds.

DIDP-E offers big wire coatings benefits

For maximum retention of elongation, tensile strength and modulus properties in wire coatings, specify Monsanto plasticizer DIDP-E (with 0.1% Bis Phenol A antioxidant added). Tests show the compound's electrical properties are equal or superior to DOP. 60° C. T or TW formulations are now available.

*Reg. U. S. Pat. Off.

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Please send:

- ☐ More information about the special surface coating process using polyester resin and glass cloth.
- ☐ Santopoid 44, Tech. Bul. O-121
- ☐ Pydraul F-9 book
- ☐ Dibutyl fumarate, Tech. Bul. ODB-54-18

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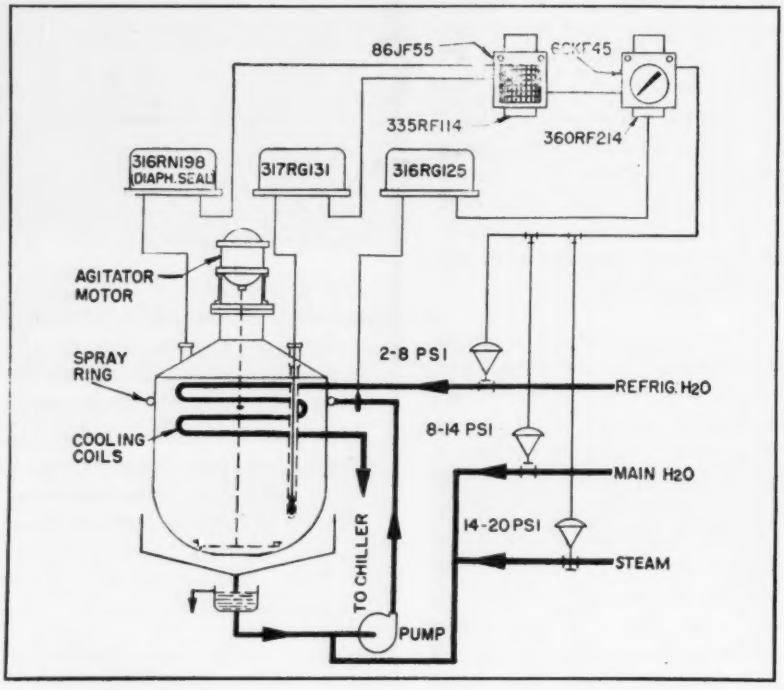
REACTOR CONTROL

One of a series of basic instrumentation recommendations for the unit operations

GEORGE E. HOWARD, Manager
Application Engineering Dept.

"Taylor pioneered in the development of control systems for chemical reactors. This recommendation is the result of many years of experience of our application engineers in handling problems inherent in this type of reactor. Data sheets on this and other reactor problems are available on request."



PROBLEM

To achieve maximum yield of specification product in the shortest possible time, with minimum cost. Optimum reaction rate is dependent on precise temperature control. This is difficult because of the lags inherent in the equipment. The principal lags are: the poor transfer of heat from product to the measuring element through a heavy protective well; and slow heat transfer into or out of the product through the vessel wall.

SOLUTION

The first lag problem is compensated for by the use of SPEED-ACT* (derivative) response in the measuring system of the TRANSAIRE* Temperature Transmitter. This permits rapid and accurate sensing of any temperature changes as the reaction proceeds.

Capitalizing on the dynamic accuracy of the TRANSAIRE Transmitter, the TRI-ACT* Controller, with its unique circuit arrangement, makes possible fast "come-up" without overshoot. Yet, it maintains the control point within extremely narrow limits regardless of process upsets. A vital contribution to this precision control is the cascade system which keeps spray-ring water temperature at the value required to accurately maintain product temperature, thus taking care of lag through the vessel wall.

The TRANSET* miniature receiver permits a continuous record of product temperature with the added convenience of auto-manual switching and remote set point change.

BENEFITS

1. Faster, safer "come-up" time.
2. Danger of wild reaction eliminated.
3. Maximum yield of specification product in shortest possible time.
4. Duplication of quality, batch after batch.
5. No loss of raw material due to over or under reaction.
6. Economical production through conservation of heating and cooling media.

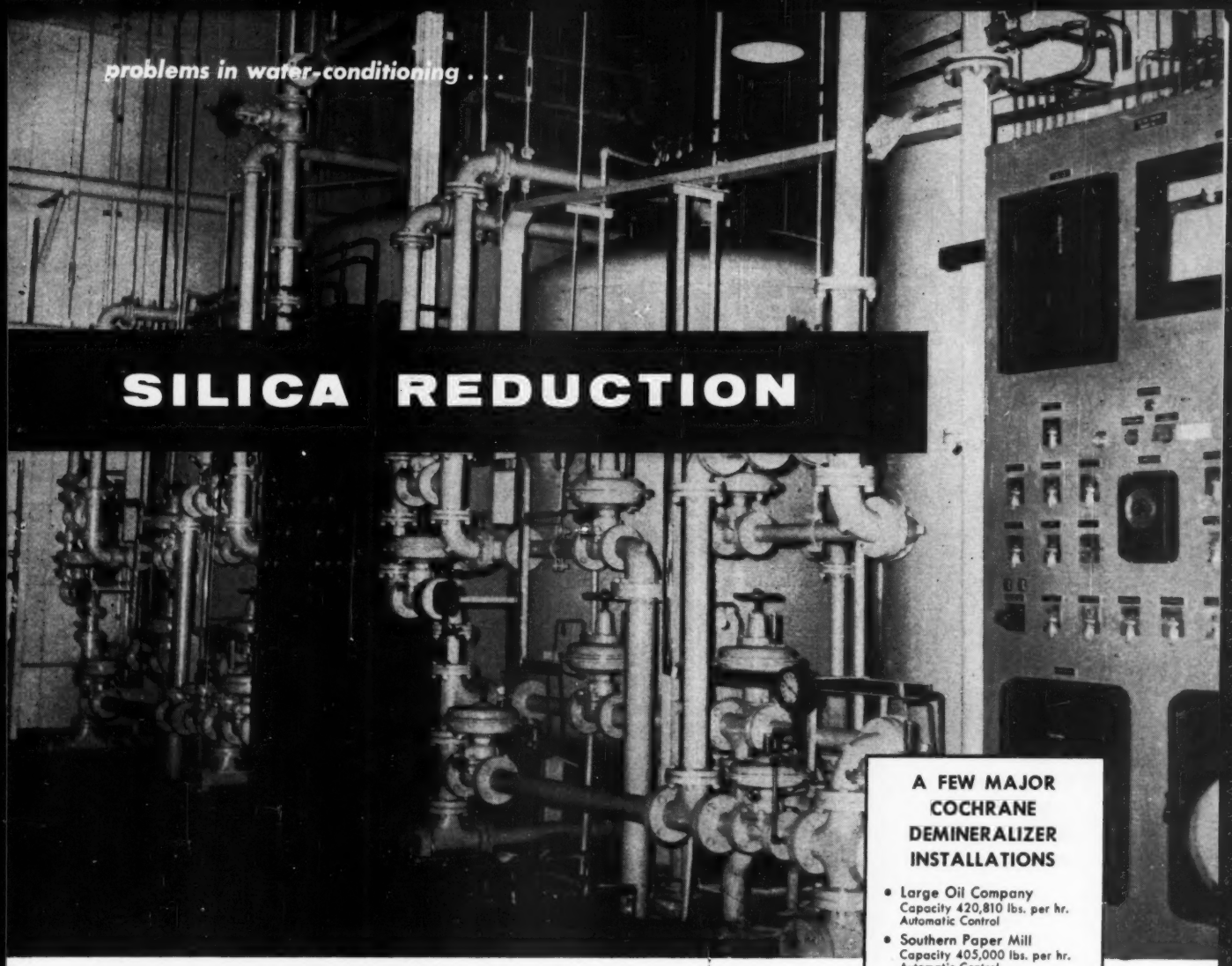
* * *

Reaction problems that might well benefit from such a control system include those involved in the production of Polystyrene, Plastics, Synthetic Rubbers, Synthetic Resins, Antibiotics, Intermediates.

Send for Data Sheet No. 9 covering in greater detail the recommended instrumentation for this and other types of reactors. Watch this magazine for future Taylor advertisements dealing in a similar manner with other unit processes. In the meantime, don't forget that Taylor Field Engineers have had intensive training and many years of experience in solving all kinds of instrumentation problems. They are ready, willing and able to serve you. Taylor Instrument Companies, Rochester, N.Y.; Toronto, Canada.

*Trade Mark

Taylor Instruments **MEAN ACCURACY FIRST**



A FEW MAJOR COCHRANE DEMINERALIZER INSTALLATIONS

- **Large Oil Company**
  Capacity 420,810 lbs. per hr.
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- **Southern Paper Mill**
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  Automatic Control
- **Textile Manufacturer**
  Capacity 360,000 lbs. per hr.
  Automatic Control
- **Utility**
  Capacity 266,400 lbs. per hr.
  Automatic Control
- **Aluminum Producer**
  Capacity 387,000 lbs. per hr.
  Automatic Control
- **U.S. Government**
  Capacity 298,800 lbs. per hr.
  Automatic Control
- **Automobile Manufacturer**
  Capacity 182,268 lbs. per hr.
  Automatic Control
- **Pharmaceutical Company**
  Capacity 29,880 lbs. per hr.
  Automatic Control
- **Chemical Manufacturer**
  Capacity 15,000 lbs. per hr.
  Manual Control
- **Steamship Installation**
  Capacity 1,776 lbs. per hr.
  Manual Control

For your protection

buy **Cochrane's** *experience*

in demineralization

An impressive list of Cochrane 2-bed, 3-bed, 4-bed and mixed bed Demineralizer installations have been providing continuous protection for years in many outstanding high pressure power plants in public utility and industrial fields.

The illustration above is just one of many such installations. Designed for a large paper company, it produces an effluent with a silica content of as low as 0.02 ppm and total dissolved solids of as low as 0.4 ppm. Cation units are 6′ x 6′ and anion units 6′ x 8′ providing demineralized water supply of over 100,000 lbs. per hour for 1200 psi boilers.

Demineralized water quality is superlative. Cochrane's progress in solving the many problems associated with demineralization is the result of untiring research by their staff of chemists, engineers and research men. This background is your assurance of satisfactory operation. Why not take advantage of it? For the answer to your water conditioning problem . . . consult Cochrane first. Ask for Bulletin 5800-B.

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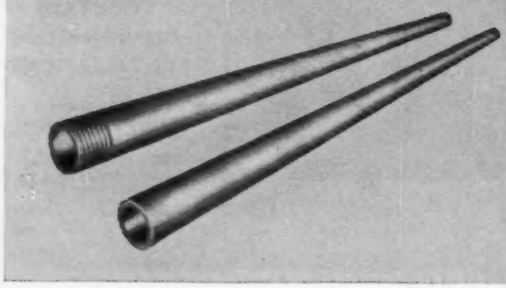
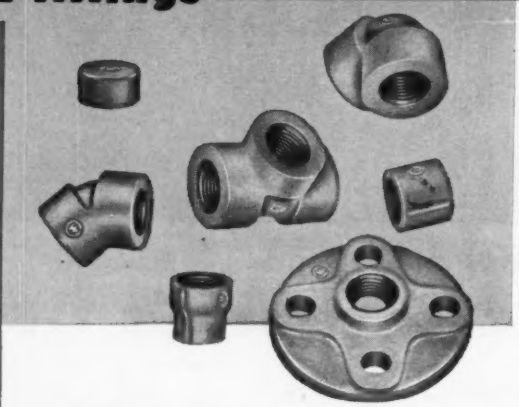
Iron... Steel... Bronze... Special Alloys and now... *PLASTICS!*

WALWORTH PVC

globe and diaphragm valves

pipe and fittings





CORROSION-RESISTANT TO GIVE YOU NEW AND LASTING PROTECTION!

Walworth rigid plastic polyvinyl chloride valves, *and* fittings provide safe, trouble-free lines to handle wet and dry hydrogen gas—sulphur dioxide—dilute nitric acid—sulphuric acid—natural gas—sugar juice—milk—vinegar—tanning solutions and literally scores of other corrosive as well as noncorrosive materials in the chemical, petroleum, pulp, paper, food and other industries.

Walworth polyvinyl chloride valves *and* fittings are molded to the *same* rigid Walworth specifications by the *same* molder—the General American Transportation Corporation—of the *same* basic material,—Geon rigid vinyl from B. F. Goodrich Chemical. Rigid plastic pipe of the same materials and made by the same molder is also available. Consistent performance is therefore assured throughout *all*-Walworth PVC piping systems. Plastic valves, fittings, and pipe offer the following advantages:

1. **Exceptionally resistant to most salts, alkalis, and nonoxidizing acids at temperatures below 150° F.**
2. **High burst strength and impact resistance.**
3. **Nontoxic, and extreme low flammability.**
4. **Easy to install.**

Get the complete Walworth PVC product story. Write for brochure containing detailed specifications, characteristics, and application data.

WALWORTH

valves . . . pipe fittings . . . pipe wrenches

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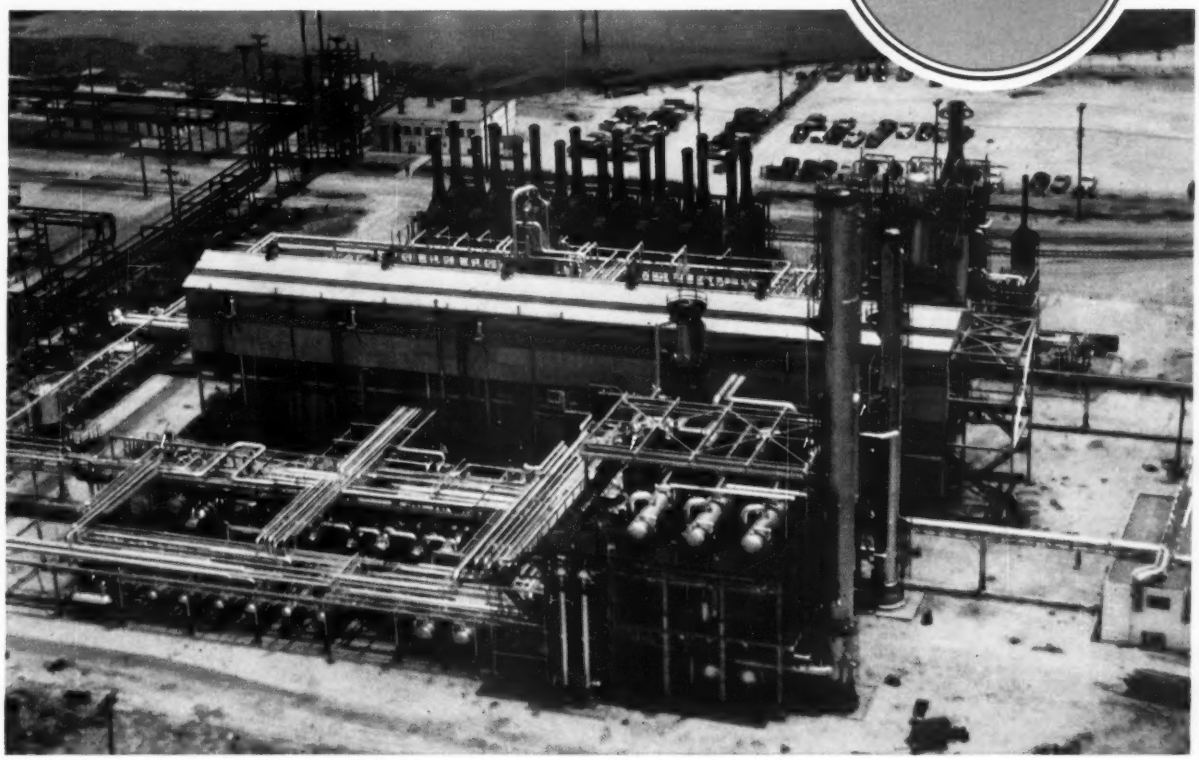

Gulf Oil Corporation's new No. 2 Ethylene Plant at Port Arthur, Texas, designed and constructed by Stone & Webster Engineering Corporation, proves again that — in *any* plant — performance is the payoff.

Stone & Webster's pyrolytic cracking process, commercially proven on feedstocks ranging from light hydrocarbons to heavy gas oils, is used in the Gulf plant designed to produce ethylene from ethane and propane.

Stone & Webster's ethylene recovery and purification processes are selected on the basis of plant experience with four basic ethylene recovery techniques. In the Gulf plant a low temperature fractionation process having many unique features was chosen to provide ease of operation with high product purity and recovery from a mixed refinery pyrolysis-gas feed.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

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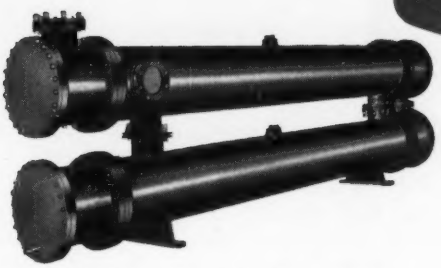
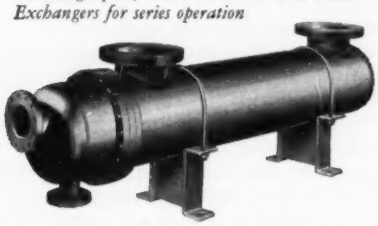
FOR LONG SERVICE
WITHOUT SERVICE

B&G
HEAT EXCHANGERS

Tank Suction Heaters • Oil Preheaters • Condensers • Evaporators • Aftercoolers • Gas Coolers Oil Coolers • Centrifugal Pumps Water Heaters



Two single pass, channel head B & G Heat Exchangers for series operation



B & G Heat Exchanger with U-bend tubing

For additional information on B & G Heat Exchangers send for Catalog DM-1150.

B & G shell and tube Heat Exchangers give you *more value per dollar because they are built that way!*

Basically efficient in design, these units are offered with straight and U-bend tubing. Ample material thicknesses in every detail and high tensile strength bolting are assurance of lasting strength and long operating life. Full tube bundles and close tolerances between shell wall and baffles prevent slippage of fluid and assure maximum heat transfer. Units can be furnished with tubing of copper, steel, several of the stainless steels and other non-ferrous alloys.

B & G Heat Exchangers are built to ASME Code U-69 requirements and can be certified by Hartford Steam Boiler and Inspection Service.

Whatever your heat exchange problems may be, remember that the B & G engineering staff is always available for consultation.

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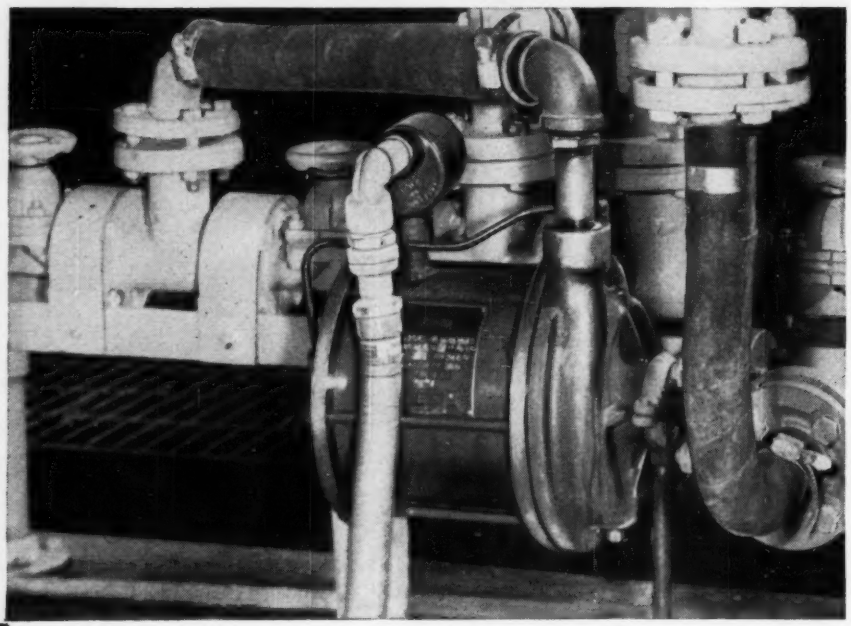
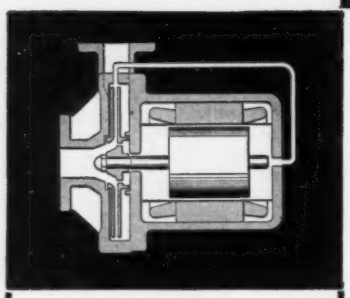
in plating operations

at Western Electric Company



Leak-proof *Chempump* installed on 270-gallon plating machine at Western Electric Co.'s Allentown, Pa. plant. Seal-less unit pumps 10 gpm of solution at 155°F against a head of 35 ft.



Chempump combines pump and motor in a single hermetic unit. Pumped fluid enters rotor chamber; no shaft sealing device required.

Approved by Underwriters' Laboratories. Available in wide choice of materials . . . from ⅓ to 7½ hp. Capacities to 250 gpm. Heads to 195 feet.

Chempump can't leak!

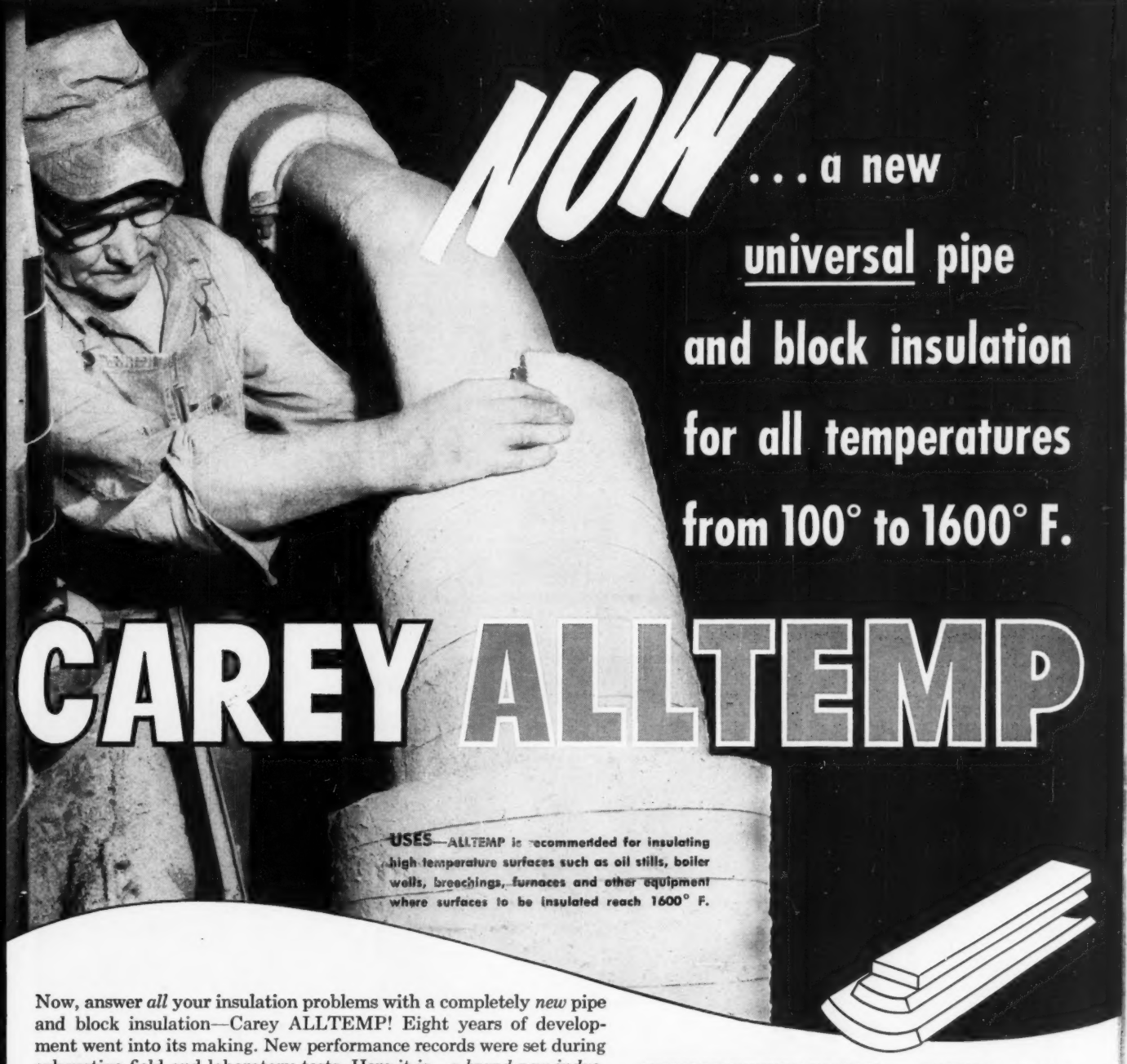
Gold plating tolerances at Western Electric's Allentown, Pa. plant are appreciably closer than in most precision plating operations. Holding these tolerances requires frequent checks on bath composition, and careful filtering and agitation of the plating solution. Selection of a leak-proof *Chempump* for this gold plating operation solves several problems. Since *Chempump* has no seals, no stuffing box, there can be no leakage of costly gold solution. Absence of any packing or other internal lubricants means complete freedom from plating solution contamination, which would seriously impair plating uniformity and product quality.

The *Chempump* runs 16 hours a day, 5 days a week. Every four months the rear bearing is replaced; the front bearing, much less often. The job takes about 20 minutes. *No other maintenance is required!*

Your process, too, can benefit with *Chempump*—the seal-less centrifugal pump that can't leak. Send for new 16 page Bulletin 1010 and get the details. Chempump Corporation, 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Engineering representatives in over 30 principal cities in the United States and Canada.

***Chempump*—first in the field . . . process-proved**



NOW . . . a new universal pipe and block insulation for all temperatures from 100° to 1600° F.

CAREY ALLTEMP

USES—ALLTEMP is recommended for insulating high temperature surfaces such as oil stills, boiler walls, breechings, furnaces and other equipment where surfaces to be insulated reach 1600° F.

Now, answer *all* your insulation problems with a completely *new* pipe and block insulation—Carey ALLTEMP! Eight years of development went into its making. New performance records were set during exhaustive field and laboratory tests. Here it is—*a brand-new industrial insulation* for all temperatures up to 1600° F.

ALLTEMP keeps every last BTU on the job producing power. Its extremely low percentage of shrinkage—approximately ⅔ *less* than other 1200° F. insulation materials—means joints won't open, cracks won't appear in covering. BTU's are *locked in!* ALLTEMP retains its high thermal efficiency and structural strength even after long, continuous exposure to excessive heat and moisture. Non-brittle, it resists blows, abrasions; won't crack or crumble under severe service conditions. And it's easy on the hands—easy to cut, fit, install!

Get all the cost-saving facts on new ALLTEMP today and your copy of the Carey ALLTEMP specification folder.

Just address coupon below.

ALLTEMP RECOMMENDED THICKNESS

Nominal Pipe Size Inches	Temperature Difference °F 80° Air					
	200	400	600	800	1000	1200
	Nominal Thickness, Inches					
1½ & Under	1	1	1½	2	2½	3
2	1	1½	2	2½	2½	3
2½	1	1½	2	2½	3	3½
3	1	1½	2	3	3	3½
3½	1	1½	2	3	3½	3½
4	1	1½	2½	3	3½	4
4½	1½	2	2½	3	3½	4
5	1½	2	2½	3	3½	4
6	1½	2	2½	3½	4	4½
7	1½	2	2½	3½	4	4½
8	1½	2	3	3½	4	4½
9	1½	2	3	3½	4½	5
10	1½	2½	3	4	4½	5
11	1½	2½	3	4	4½	5
12	1½	2½	3	4	4½	5
14 & Over	1½	2½	3½	4	4½	5½

ALLTEMP is available in clean, easy-to-handle flat and preformed blocks. "Nesting" O.D. pipe covering sizes provide accurate, tight fits for multiple layer construction. Only a limited number of "prime" units are necessary for unusual assemblies.

Better Products for Industry Since 1873

Carey

THE PHILIP CAREY MFG. COMPANY
Lockland, Cincinnati 15, Ohio
In Canada: The Philip Carey Co., Ltd., Montreal 3, P.Q.

Carey-approved contract units in major trading areas. Consult your nearest Carey District Office or your Telephone directory.

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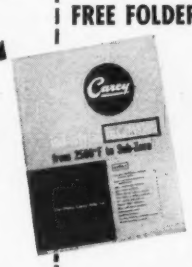

THE PHILIP CAREY MFG. COMPANY
Lockland, Cincinnati 15, Ohio • Dept. CE-10

Please send free illustrated folder showing specifications, installation details and complete facts on new ALLTEMP insulation.

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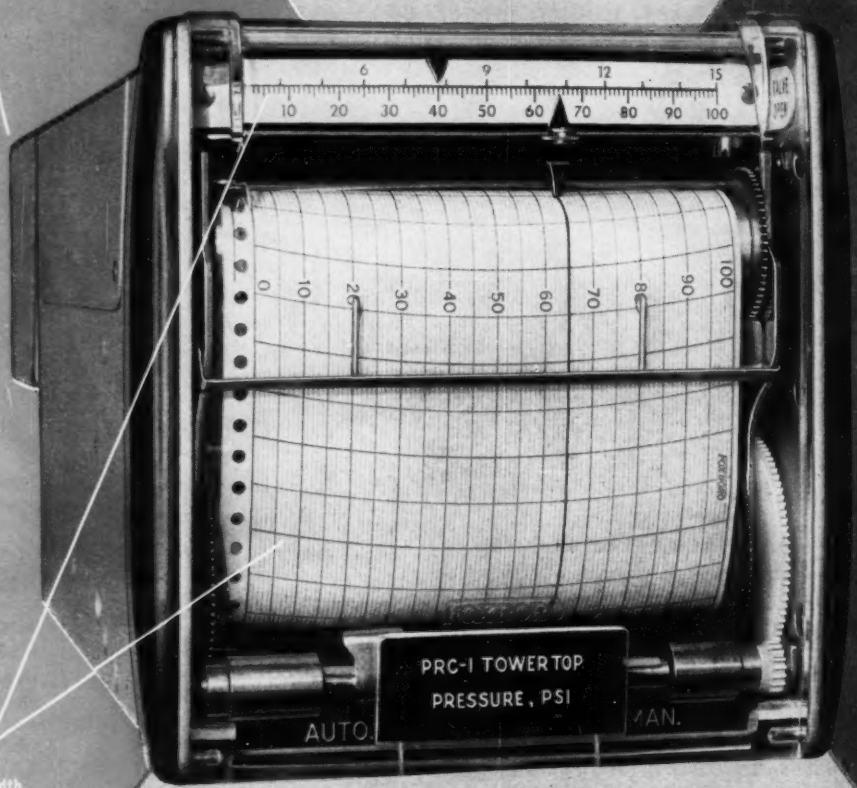
compactness with nothing sacrificed!



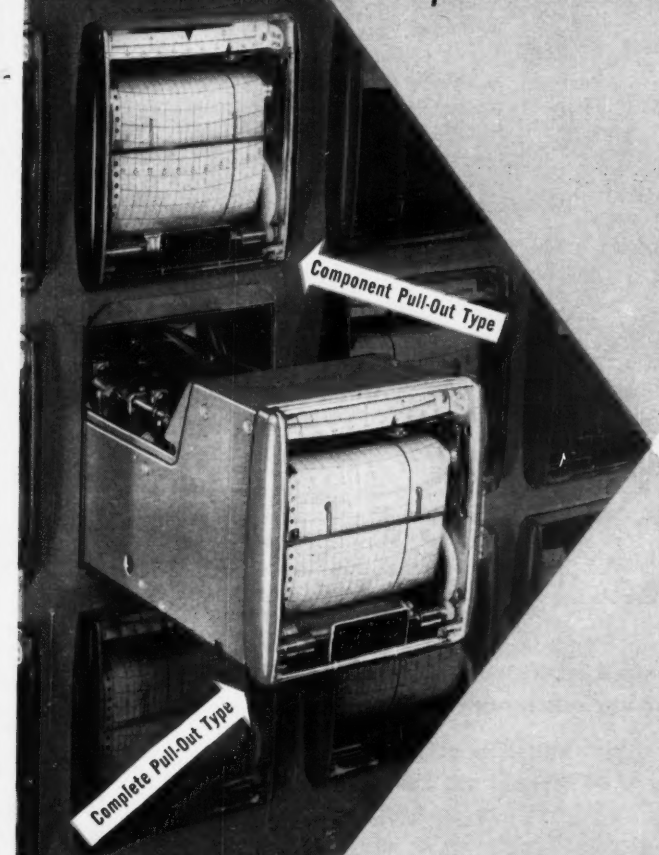
Models to Meet All Your Specifications

In all the following CONSOTROL instruments, recorder and indicator units can be easily converted in field.

- Recording Control Station with automatic/manual transfer
- Recording Control Station with manual loading only
- Recorder — single or two pen
- Indicating Control Station with automatic/manual transfer
- Indicating Control Station with manual loading only
- Indicator — single or two pointer

CONSOTROL

small-case panel instruments



Here's the "tops" in centralized recording and control efficiency! CONSOTROL* Instruments require the minimum of valuable panel space, yet provide unsurpassed operator convenience, visual accuracy, and ease of maintenance . . . maintain the highest standards of precision and dependability. For example: the simple CONSOTROL method of switching from automatic to manual control requires no memory or extra operations . . . never "bumps" the process. All CONSOTROL charts and scales are full 4-inch width for greatest visibility . . . highest accuracy. When it comes to servicing, there's plenty of "finger room" . . . all parts are uncrowded and easily removable. And just compare inking requirements with other designs. CONSOTROL needs ink filling only once or twice a year! These are only a few of CONSOTROL's advanced design features — available in both fixed-mounting and full pull-out type instruments. Get the complete story. Write for Bulletin 13-18. The Foxboro Company, 748 Neponset Avenue, Foxboro, Mass., U.S.A.

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Consotrol Process Control

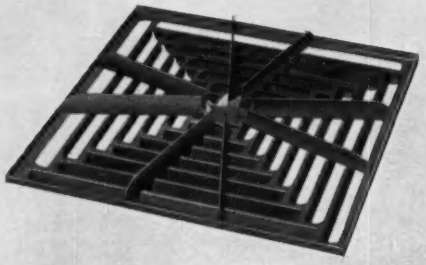
FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

American Blower Vertical Unit Heaters offer you

Air-flow control with Equitemp Air Diffusers

Capacities: 58,400 to 560,000 BTU at 2 lbs. steam pressure, 60° entering air.

VERTICAL UNIT HEATERS

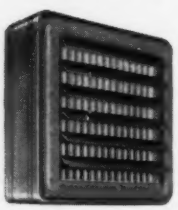


Adjustable Equitemp Air Diffuser lets you tailor heat flow to the job.

Equitemp Air diffusers are *standard equipment* on American Blower Venturafin Vertical Unit Heaters. Extremely versatile, this unique air diffuser lets you control heat distribution at all mounting heights by simple hand adjustment.

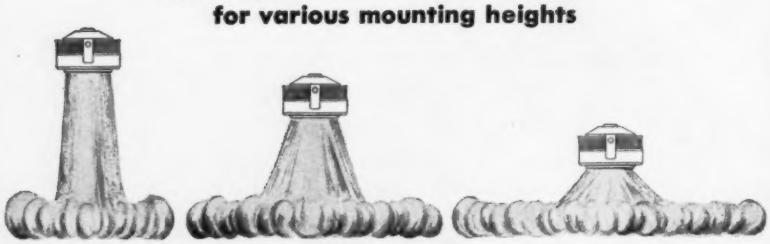
At low mounting heights, for example, the Equitemp Diffuser can be adjusted to eliminate the blast of heated air that so often bothers employees directly beneath. Yet, for high-ceiling mountings, diffuser vanes may be left in vertical position for maximum blow. Anemostat and vane-type diffusers also available.

Select low-cost, quiet-operating Venturafin Unit Heaters for *your* next job. For data, consult your nearest American Blower Branch Office. Do it, today!



For applications requiring heaters with horizontal blow, American Blower offers a wide selection. Capacities: 18,000 to 357,500 BTU at 2 lbs. steam pressure, 60° entering air.

Equitemp Air Diffusers are adjustable for various mounting heights



High ceilings Medium ceilings Low ceilings

Other American Blower Unit Heaters

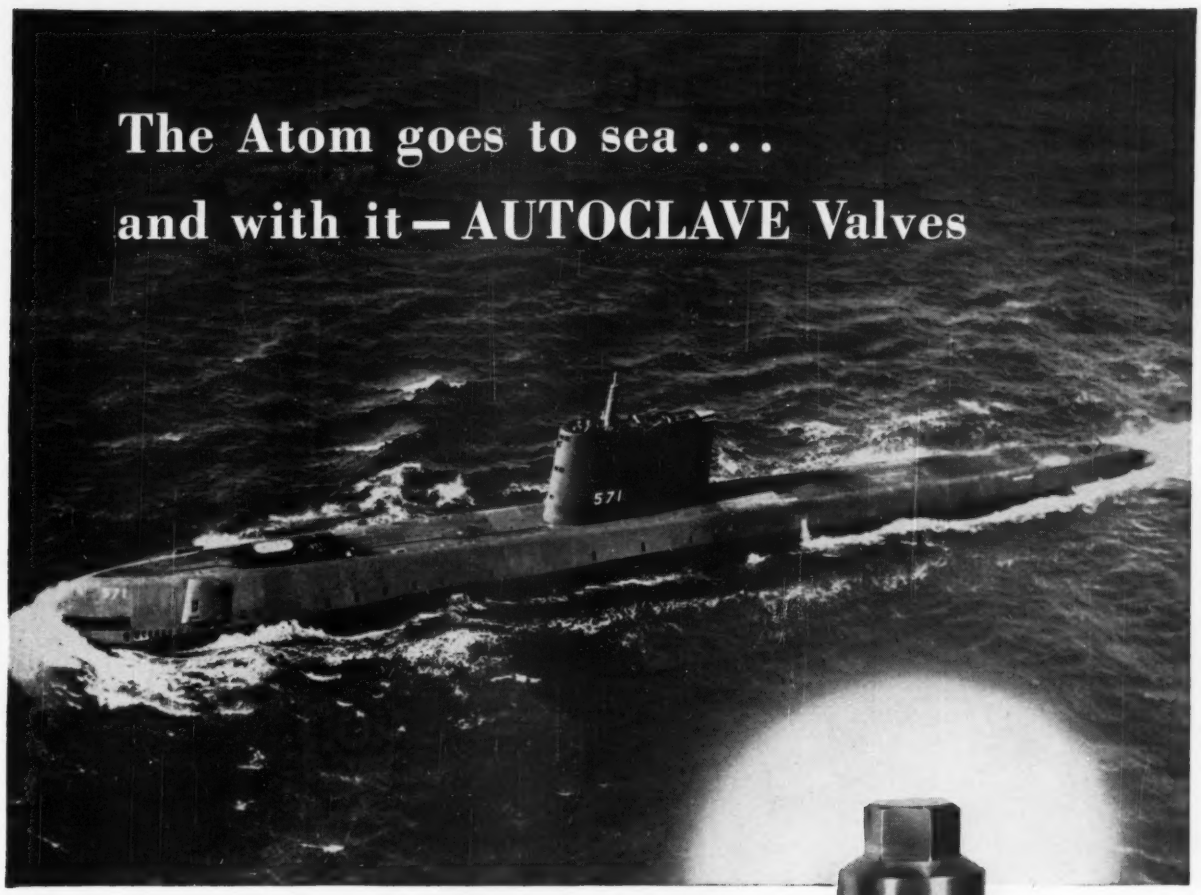
American Blower's gas-fired unit heaters and de luxe cabinet heaters for commercial and industrial use are compact, efficient and easy to install.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

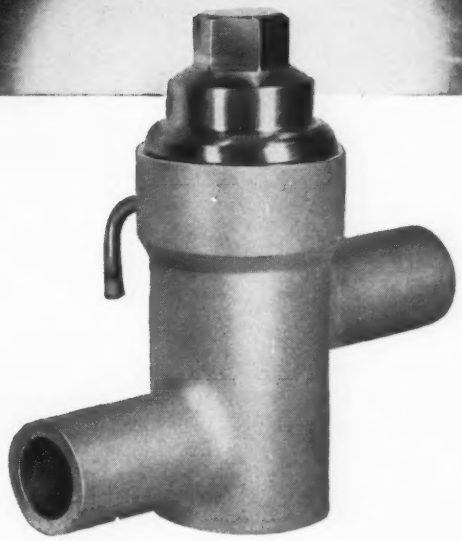
Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE
DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

The Atom goes to sea . . .
and with it—AUTOCLAVE Valves



THE world's first atomic powered underwater ship—United States Navy Submarine Nautilus—carries within her hull, special valves engineered and manufactured by AE .

The same engineering skill and craftsmanship which AE contributes to the maritime alertness of the Nautilus, is available to you in meeting the problems of your research and development work. Consult with us on your pilot plant and laboratory requirements for high pressure equipment.



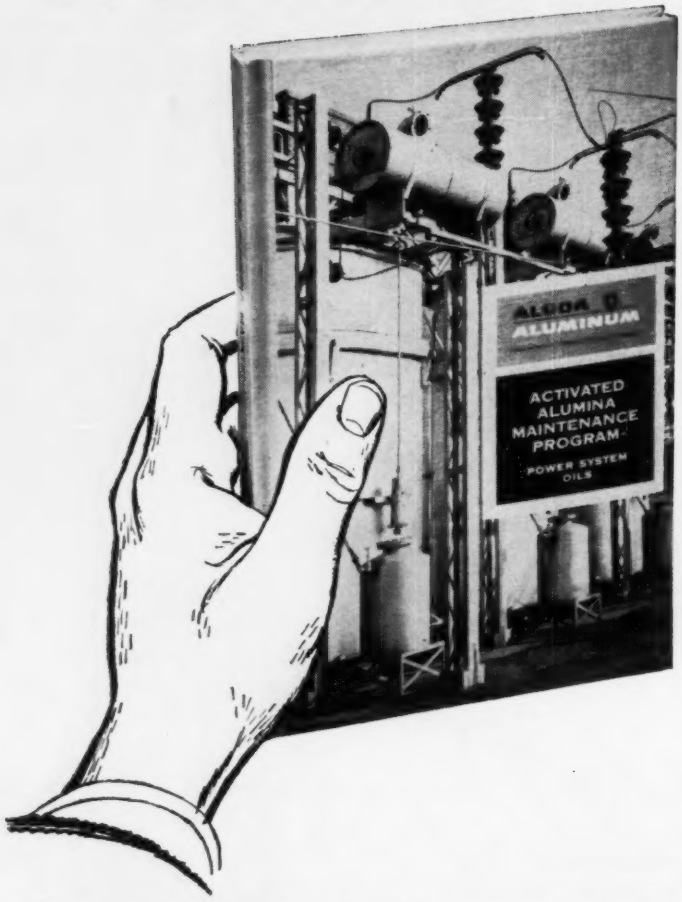
SPECIALISTS IN LABORATORY AND PILOT PLANT HIGH PRESSURE EQUIPMENT

AUTOCLAVE ENGINEERS, INC.

860 EAST 19TH ST. • ERIE, PENNSYLVANIA

Reduce power plant costs with this oil maintenance program

NEW, FREE ALCOA BOOK TELLS HOW



This new ALCOA book brings you the latest developments on the use of ALCOA® Activated Alumina for maintenance of insulation oil and lubricants. Illustrated with 33 photographs, designs and diagrams, this 5½ x 8½ inch book contains 120 fact-filled pages.

Over a period of many years, ALCOA has developed suitable procedures for the maintenance and reclamation of power system oils, using ALCOA Activated Alumina. Results have thoroughly established the effectiveness and value of these methods. The manual provides complete, detailed instructions for the installation and operation of this amazingly efficient program for power system oil maintenance. Write today for your copy of the valuable book.

HOW TO GET YOUR FREE COPY

Write on your company letterhead for *Activated Alumina Maintenance Program—Power System Oils.* ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 702-K Alcoa Building, Pittsburgh 19, Pa.

ALCOA CHEMICALS
ALUMINUM COMPANY OF AMERICA

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reach a new peak with YARWAY

in spraying efficiency non-clog nozzles

cone spray

Most popular design for cooling, recooling, washing, rinsing, air conditioning, drying and other spraying operations in industrial and processing work and in power plants.

Non-clog involute design has no internal parts (vanes or deflecting plates) on which foreign particles can collect. Special contour of nozzle body guides flow with minimum loss of energy towards discharge opening, where liquid attains maximum velocity and leaves nozzle in a fine hollow-cone spray.

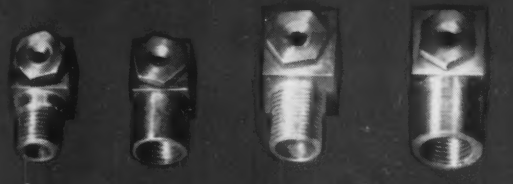
Available in three types:

Bar-stock bronze (shown) for fine spray
Sizes ¼" and ⅜", male or female connection
Capacities up to 3 gpm; pressures 20 to 50 psi

Cast bronze Type B (shown) for air conditioning and small recooling systems
Five sizes, ½" to 1½"
Capacities up to 40 gpm; pressures 7 to 25 psi

Cast bronze Type C (not shown) for spray pond service
Sizes 2" and 2½"
Capacities up to 110 gpm; pressures 7 to 15 psi

Write for YARWAY Spray Nozzle Book N-617; it gives capacities, dimensions and application information.



YARWAY Bar-Stock Involute Nozzles

YARWAY Type B Involute Nozzles

fan spray

Preferred for many washing and cooling operations. Non-clog design, delivers flat fan-shaped sheet of spray with slicing action particularly desirable for surface washing.

Thin sheet of spray is discharged forward 30° from the vertical, spreading in fan shape up to 140°, depending on operating pressure.

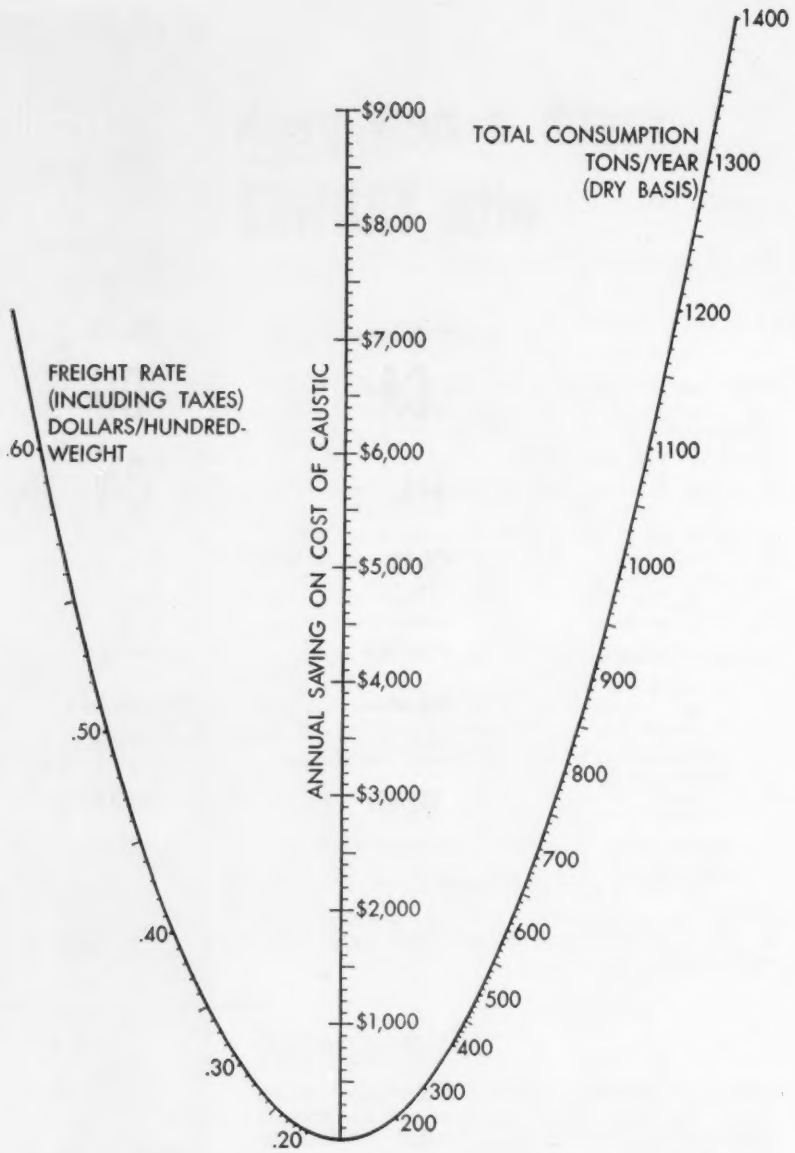
Made of bronze, steel or other bar-stock metals, male thread, six sizes ⅛" to 1", capacities up to 7 gpm, pressures up to 50 psi.

Write for YARWAY Spray Nozzle Book N-617.

YARWAY Fan-Spray Nozzles

YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY® spray nozzles



Which saves you more... **50% or 73% Caustic Soda?**

This nomograph can help you decide Are you using the caustic solution that's least expensive for you? A few seconds' calculation with this nomograph will help you decide.

How to find if you can save on 73% caustic soda Simply draw a line from your freight rate (including taxes) to your annual consumption in tons on a dry basis. Your approximate savings will appear where this line intersects the center line of the nomograph.

This figure represents your savings on freight charges after the $2.00 premium price on 73% caustic soda has been deducted.

From this figure you must deduct a depreciation charge based on the cost of dilution equipment. Your Hooker technical service man is ready to advise you on the equipment needed and its cost.

Double-check your findings this way Before you make a final decision on 50% or 73%, give yourself the advantage of expert technical advice. Let your Hooker technical service man show you what equipment you will need for 73%. He will figure your exact savings—based on a realistic study of your operations.

For quick service, write or phone the nearest Hooker office.

"CAUSTIC SODA BUYER'S GUIDE" is the title of a new pocket-size booklet we'll be glad to send you free. Contains helpful facts on the economics of 50% and 73% solutions; other forms of caustic soda; capacities of tank cars and other containers; useful shipping information. Write us for a copy.

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1905—Half a Century of Chemicals
From the Salt of the Earth—1955

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ENGINEERING
REPORTS:

HOW G.E. CAN HELP YOU MEET INCREASED CHEMICAL PRODUCTION REQUIREMENTS

A NET EARNINGS RECORD YEAR, predicted at 10% above 1954, will be the result of increased production and sales in 1955. To meet production demand, chemical producers must continually review their plant electrical requirements. The G-E engineer's approach to your plant's increased electrical needs is through electrical systems that are . . . 681-8

- **Adaptable to existing plant set-ups**
- **Designed for future expansion**
- **Flexible in application**
- **Easily maintained, durable and efficient**

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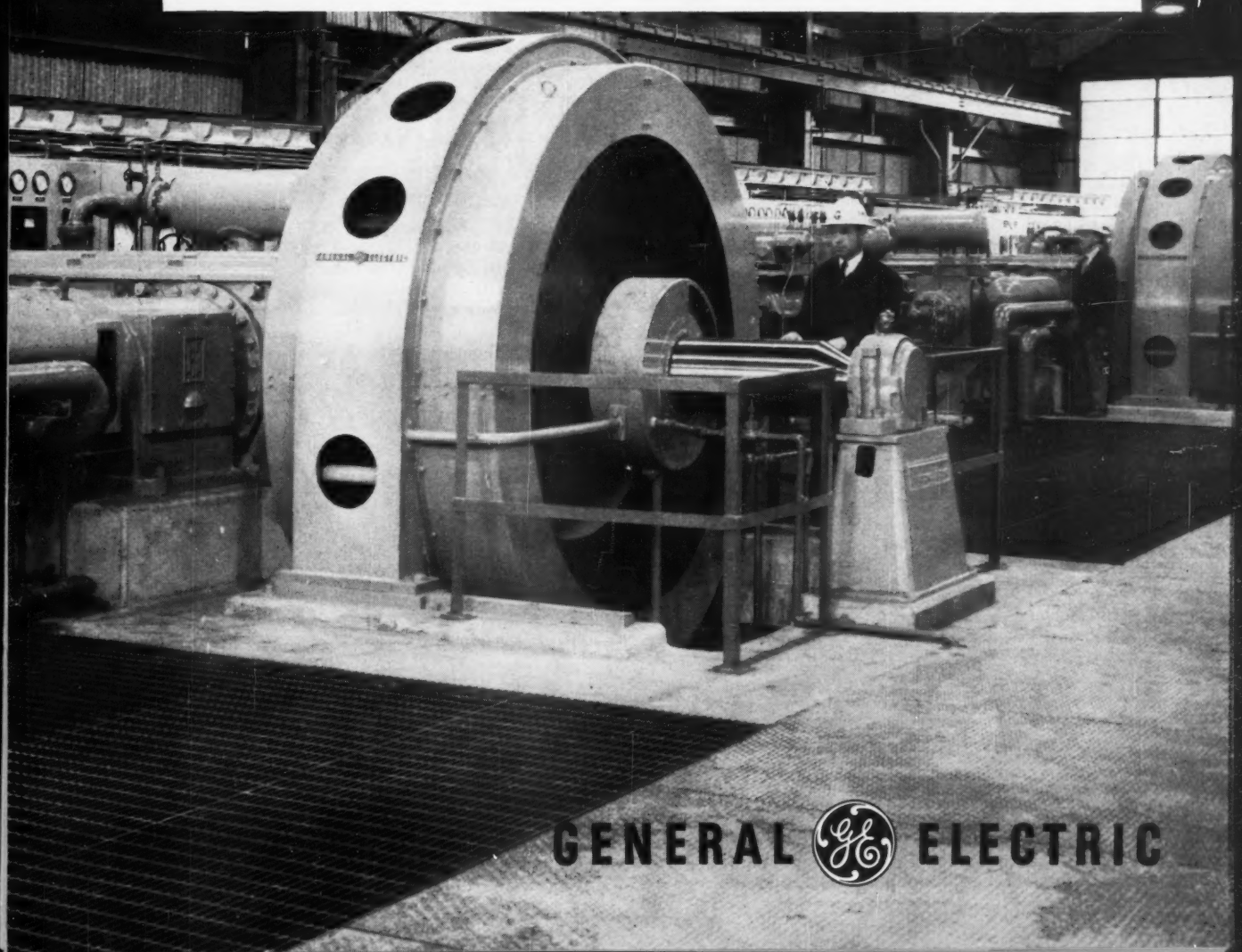

GENERAL ELECTRIC

SEVERAL AVAILABLE TYPES of protective enclosures make G-E motors ideal for all indoor or outdoor uses. New Polyex insulation

G-E ENGINEERED DRIVES AND POWER SYSTEMS MEAN . . .

Modern, more flexible processing lines

IN THE NEXT TEN YEARS, production must increase an estimated 50% to meet greater consumer needs. Available manpower will increase only an estimated 14% during the same period.

INCREASED OUTPUT AND EFFICIENCY must close the production gap between available manpower and estimated demand. General Electric electrical systems are designed and installed for efficient, flexible, easily expanded production.

G-E ENGINEERING SERVICES (see back page) can help you meet production requirements to bring your electrical system up to date. The result is a modern system integrated into your present plant setup.

FOR ADDITIONAL INFORMATION on how G-E engineered systems and engineering services can help you, contact your G-E Apparatus Sales Representative during your early planning at the nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y.

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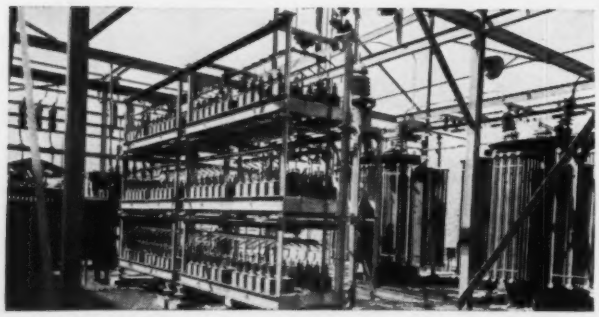
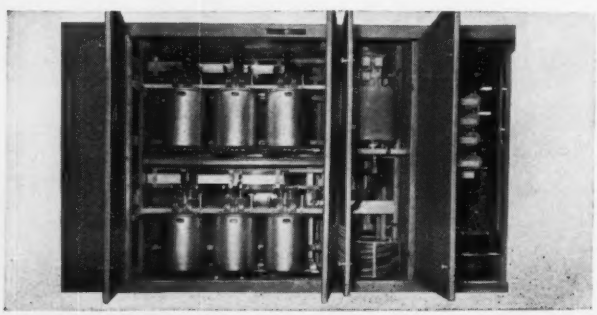
Engineered Electrical Systems for Process Industries

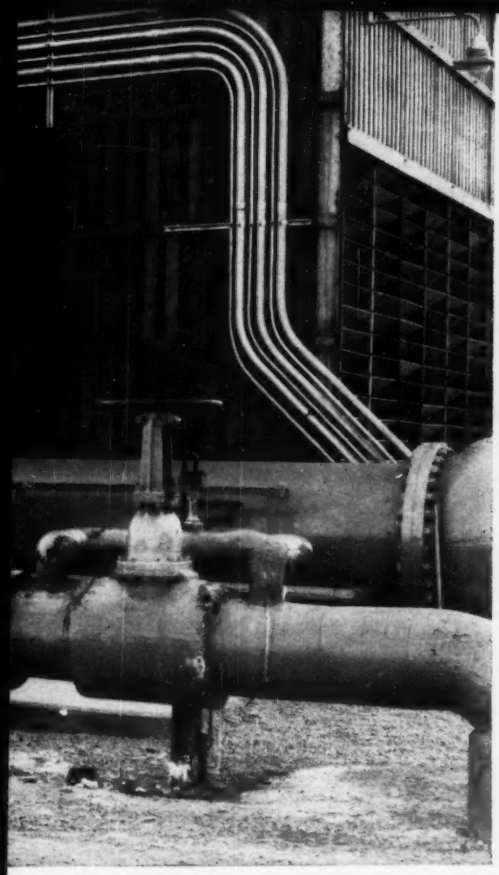
GENERAL ELECTRIC



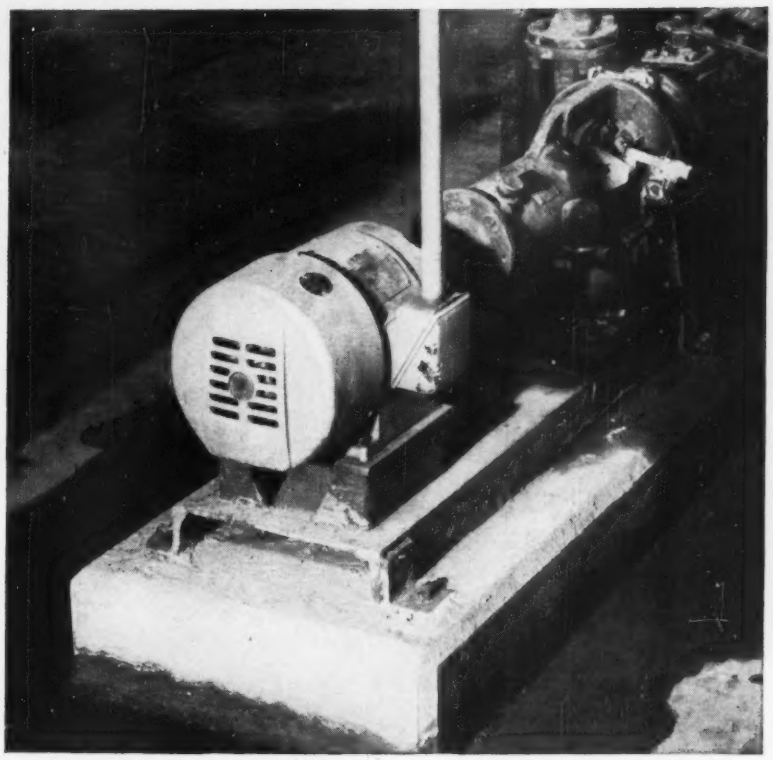
"BUILDING-BLOCK" design of this stack-rack capacitor block reduces installation costs. This design means equipment may easily be expanded or moved to meet plant requirements.



HIGH EFFICIENCY and low installation cost of this pumpless rectifier provide more reliable and economical d-c power. Factory wired, the unit is ready when it arrives to connect and operate.



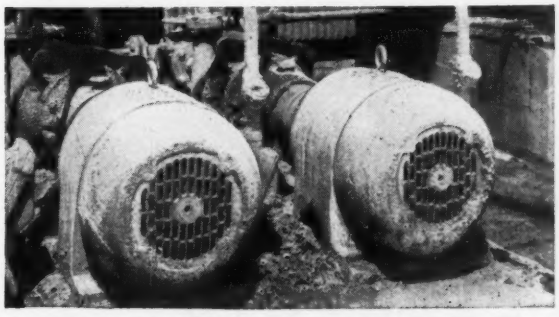
gives up to 50% longer motor life.



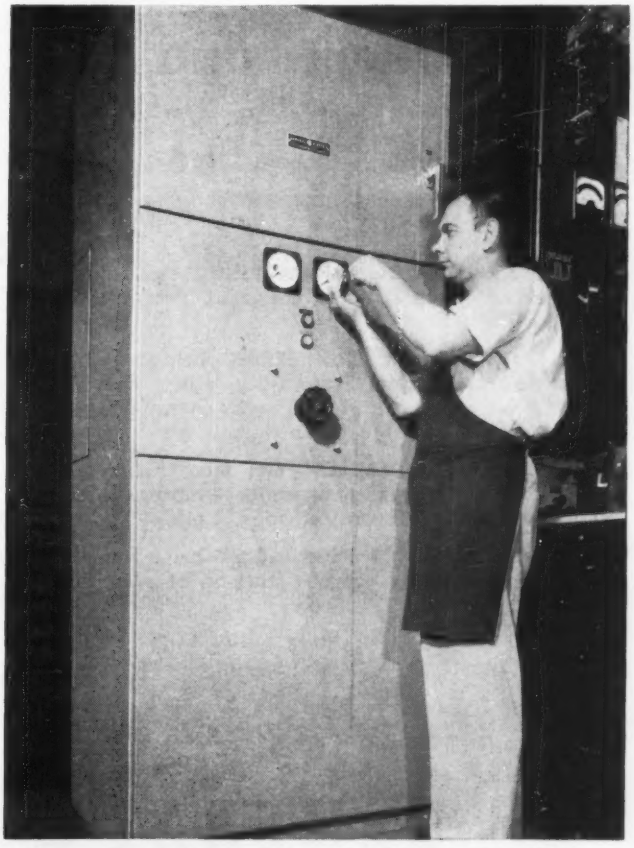
NEW G-E TRI-CLAD* '55' MOTORS, totally enclosed, are suitable for damp areas, even where hosing is necessary. New cooling system cleans while it cools motor.

for your plant

G-E MAGNETIC STARTERS and safety switches are compact, for maximum space savings. Short-circuit protection is provided by circuit breaker or fusible disconnect switch.



CORROSIVE ATMOSPHERE effects are greatly minimized in these G-E Tri-Clad induction motors. Rugged cast-iron construction makes them excellent for process application.



SHORT CIRCUIT PROTECTION up to 60,000 amps, plus 50% greater space savings are provided by all-new G-E Limitamp*.

Reg. Trademark of General Electric Company

SIX G-E ENGINEERING SERVICES . . .

HELP YOU PROTECT YOUR EQUIPMENT INVESTMENT

1 **G-E APPLICATION ENGINEERING** helps you and your consultants design the right electric system for your plant.

2 **G-E ANALYTICAL ENGINEERING** helps attain the optimum electrical system for your application. Engineering experience backed up by electronic system analyzers save valuable design time.

3 **G-E PRODUCT DEVELOPMENT** laboratories design and test new equipment under tomorrow's conditions to meet your future demands.

4 **G-E FIELD-SERVICE ENGINEERING** helps you supervise installation, expedite start-up of your major electric equipment.

5 **G-E MAINTENANCE SERVICE** from 36 G-E Service Shops will repair and uprate your old equipment, help establish productive maintenance of your equipment, furnish emergency service.

6 **G-E PROJECT CO-ORDINATION** means on-time engineering, shipment, installation of your electric equipment from preliminary diagrams through start-up.

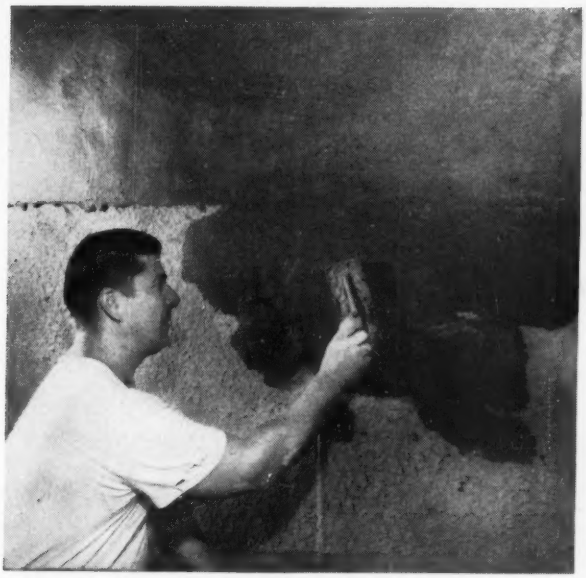
These valuable services are available to you with General Electric equipment. Contact any General Electric Apparatus Sales Office. Meanwhile, for the full story of G-E engineering services, write for brochure GED-2244, General Electric Co., Section 681-5, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

EAGLE-PICHER
SUPER "66"
INSULATING CEMENT

→ *STICKS* to hot or cold surfaces ←



BECAUSE IT STICKS, *it saves time*! Eagle-Picher Super "66" *really sticks,* makes difficult jobs easy, usually requires no reinforcing on applications up to 1½ inches thick. It applies quickly to any equipment, cold or heated up to 1800 F.

BECAUSE IT STICKS, *it saves money*! Low-cost Super "66" provides far greater coverage and more effective insulation. Its "springy ball" structure of small, resilient pellets of mineral wool, with thousands of dead air cells, assures maximum fuel savings!

BECAUSE IT STICKS, Eagle-Picher Super "66" can be used on irregular shapes where application of other insulations is often impossible.

PREVENTS RUST, TOO! Super "66" contains a special rust inhibitive that actually prevents corrosion.

WRITE FOR FREE SAMPLE TODAY!

Prove to yourself how easy it is to apply Super "66" wherever insulation is needed!

Since 1843

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY

Producing a complete line of industrial insulations

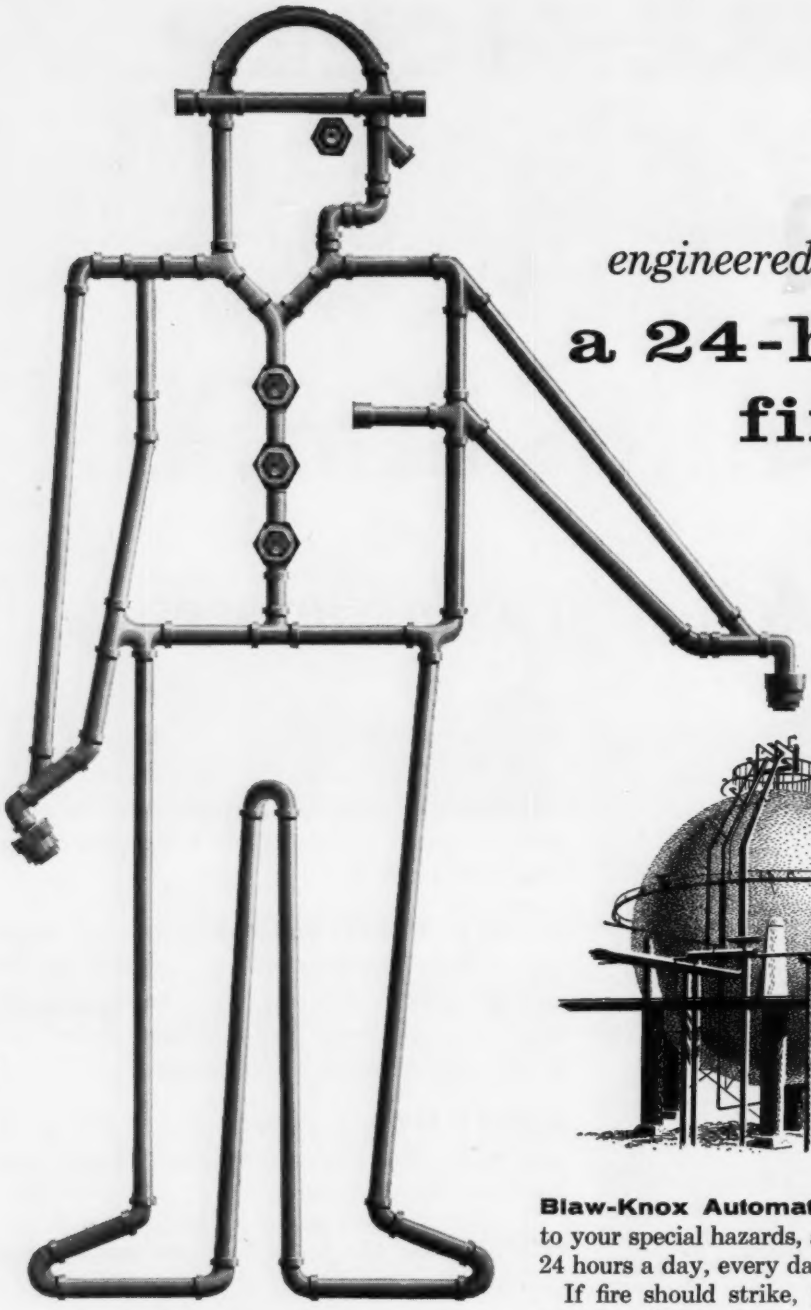
Cincinnati 1, Ohio

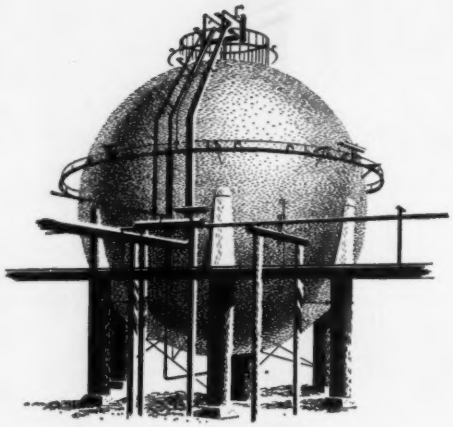
(Member of Industrial Mineral Fiber Institute)

(Conforms to Commercial Standard CS117)

engineered by Blaw-Knox...

a 24-hour fire guard





Blaw-Knox fire protection systems carry approvals of all insurance underwriters.

• Deluge Systems • Wet Pipe Systems • Dry Pipe Systems • Water Spray and Fog Systems • Rate-of-Rise Sprinkler Systems • Foam and Carbon Dioxide Extinguisher Systems

Blaw-Knox Automatic Fog Systems, engineered to your special hazards, are fire guards that work for you 24 hours a day, every day in the year.

If fire should strike, your Blaw-Knox fire protection system will smother flames and dissipate heat quickly, thus checking possible loss of equipment and lives. It will also save you from such "hidden" dangers as loss of profits during downtime and loss of customers, possibly forever.

Blaw-Knox engineers have wide experience in water fog protection of chemical installations. We will gladly submit a layout and cost estimate of your requirements at no obligation. Why not call us today?

Send for a copy of our booklet, "Fire Can Destroy Your Business." You'll find it full of interesting facts.

"Little Joey Sprinkler" always on the job

BLAW-KNOX

BLAW-KNOX COMPANY

Automatic Sprinkler Department / Pittsburgh 33, Pa.

Here Is Extra Motor Value

Double-shielded bearing
Large grease reservoirs
Bolted-on bearing cap
Labyrinth seals

This Allis-Chalmers Bearing Design Gives More for Your Motor Dollar

The bearing cap is held tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

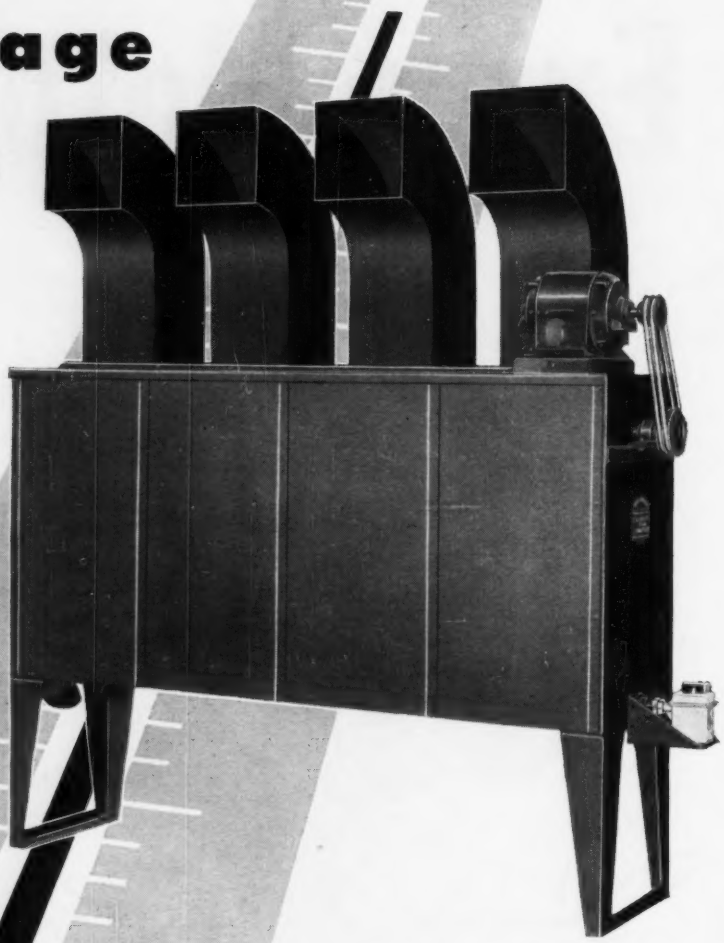
You can lubricate these bearings without dismantling motor. Pipe-tapped holes in the bearing housings at two points provide means for inserting new grease, flushing out old grease and of relieving pressure during re-greasing.

Look for the extra bolts on the end housing . . . the sign of greater value. Ask your Allis-Chalmers representative or Authorized Distributor to show you a cutaway section of this maintenance-cutting design. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B7225.

A-4616

ALLIS-CHALMERS

YOUR FUEL COSTS go down when Clarage Unitherms go in...



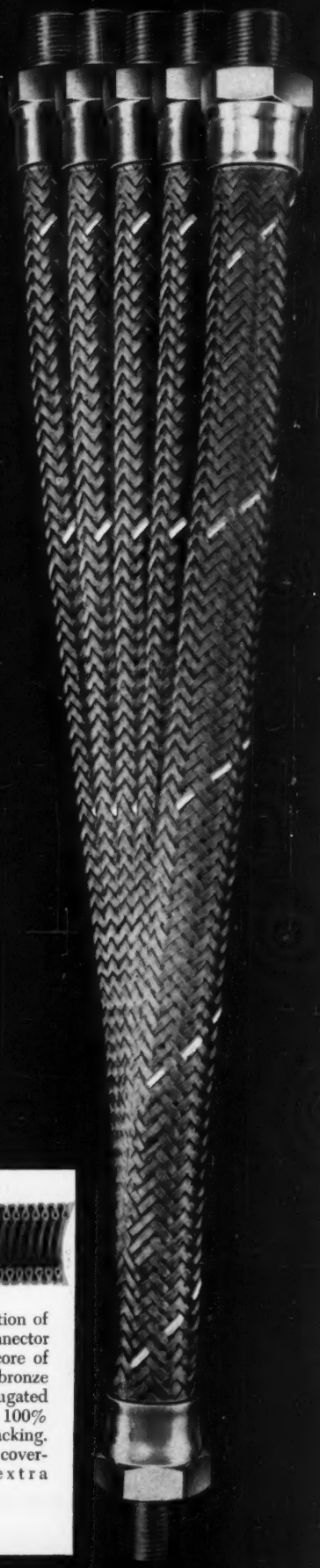
AMONG the many prominent users — Sutherland Paper with 13 Unitherms and 48 Clarco Unit Heaters (suspended models for smaller area service) in its newest plant.

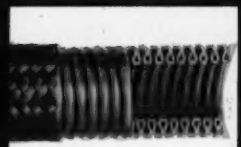
Exclusive Feature saves you money

Clarage's unique Syncrotherm Control maintains uniform heating with relatively low temperature air in constant circulation. By-pass dampers control the amounts of air passing through and around heating coil. Result: better use of each BTU at lower cost. Investigate this and the other features of the Unitherm Unit Heater — available for steam or hot water operation, floor or ceiling installation, in a wide size range. Write for Catalog 1115. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE . . . . . ***dependable equipment for making air your servant***

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal





Cutaway section of Flexpipe Connector shows how core of seamless, tin bronze tubing is corrugated for flexibility. 100% tight. No packing. Wire braid covering for extra strength.

NOW... a new, standard *flexible* connector to save the cost of special design

FLEXPIPE* permits travel... absorbs vibration ...connects misaligned ports in pipe lines

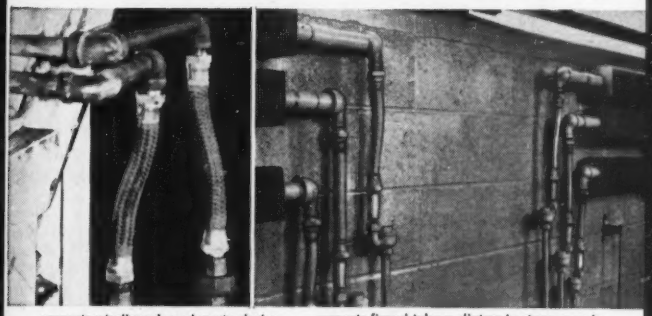
Here's a new, *standard* tin bronze flexible connector you can use to convey air, gas, oil, steam or water. Flexpipe Connectors have standard plated brass pipe fittings at each end. They permit travel, flex with motion, and dampen vibration. They save time and materials by taking the place of rigid connections made up on the job with elbows, couplings and short runs of pipe. When intermittent travel occurs, Flexpipe Connectors move with the pipe, relieving stresses which shorten the life of rigid connections.

Flexpipe Connectors are designed for wet heating systems, and for trouble spots in commercial and industrial piping. Sizes, lengths, part numbers and operating pressures are given in the table below.

I.D.	Max. Offset each side of C/L (intermittent travel)	Over-all Length Inches	Part Numbers	Max. Working Pressure at Room Temp. PSI	Max. Working Pressure at Max. Temp. (350°F) PSI
¼	½ 1¼	8 16	¼ M-10 ¼ M-20	1200	850
⅜	½ 1¼	9 18	⅜ M-10 ⅜ M-20	1000	700
½	½ 1¼	10 20	½ M-10 ½ M-20	750	525
¾	½ 1¼	11 22	¾ M-10 ¾ M-20	600	425
1	½ 1¼	12 24	1 M-10 1 M-20	550	375
1¼	½ 1¼	13 26	1¼ M-10 1¼ M-20	300	200
1½	½ 1¼	14 28	1½ M-10 1½ M-20	275	175
2	½	18	2 M-10	200	125

SOLD BY LEADING WHOLESALE DISTRIBUTORS

55204 (Rev.) *Trade Mark



.. connects misaligned condensate drains ... connects finned tube radiators to steam supply

AN **Flexpipe ANACONDA®** PRODUCT

The American Brass Co., American Metal Hose Div., Waterbury 20, Conn.
In Canada: The Canadian Fairbanks-Morse Co., Ltd. CE

☐ Please send me more information on Flexpipe.

NAME.....

COMPANY.....

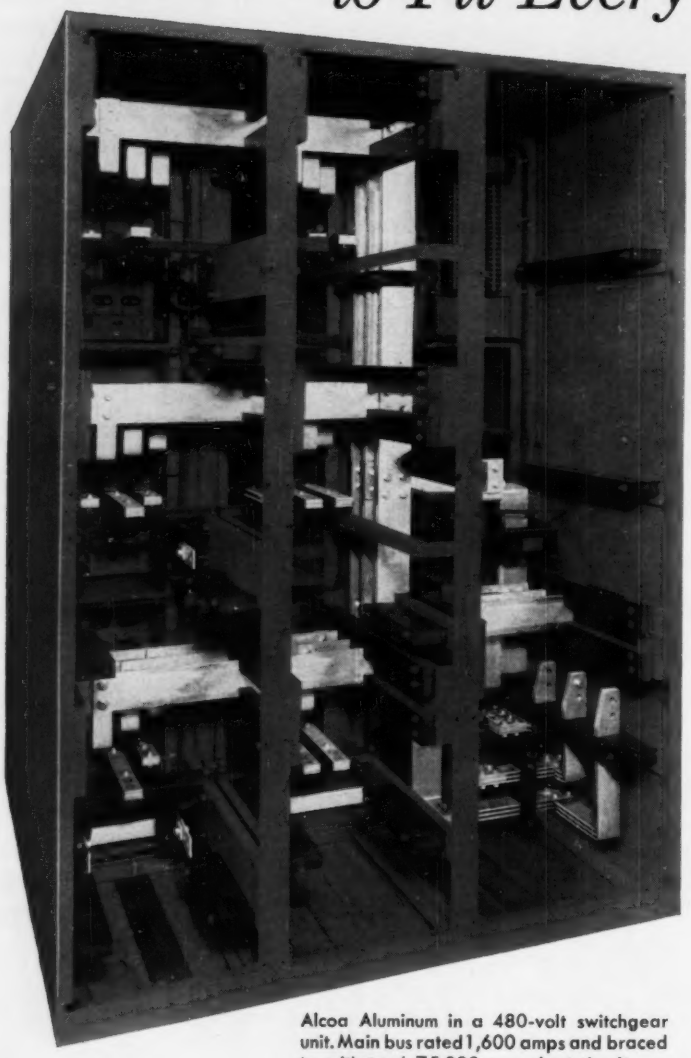
ADDRESS.....

CITY.....ZONE.....STATE.....

My Distributor's Name.....

City.....State.....

There's an Alcoa® Aluminum Bus Conductor Engineered to Fit Every Bus Application



Alcoa Aluminum in a 480-volt switchgear unit. Main bus rated 1,600 amps and braced to withstand 75,000-amp short circuit.

Here is a recent switchgear application of Alcoa Aluminum Bus Conductors. Earlier Alcoa Aluminum Bus Conductor installations of this type are still in operation after thirty years of heavy-duty service in electrochemical plants, steel mills and public utilities.

Alcoa offers shapes, alloys and tempers designed to meet even the most specialized mechanical and electrical requirements, giving you significant savings in material and installation costs. Whatever your installation or bus design problem is, there's an Alcoa Aluminum Bus Conductor so right for the job it's almost custom fabricated.

Let us help you with your design to get the most out of the many types of Alcoa Aluminum Bus Conductors available. If you'd like to see what you can expect of this modern electrical metal, ask your local Alcoa sales office for a copy of *Service Records of Alcoa Aluminum Bus Conductor Installations*. Or write Aluminum Company of America, 2309-K Alcoa Building, Mellon Square, Pittsburgh 19, Pennsylvania.

Your Guide To Aluminum Value

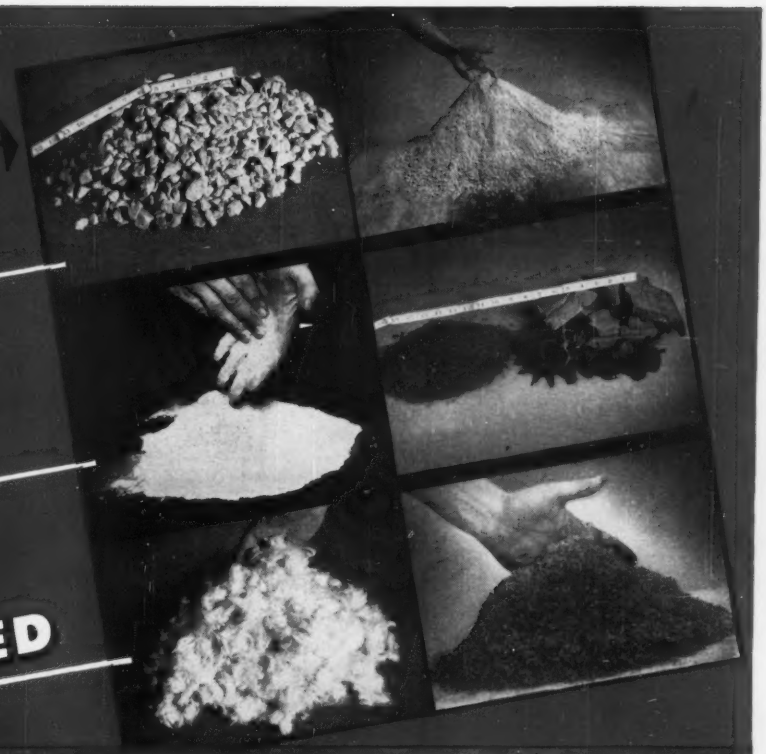
ALWAYS USE ALCOA ALUMINUM ACCESSORIES WITH ALUMINUM CONDUCTORS

If You Want it

CRUSHED

GROUND

SHREDDED



There's a WILLIAMS Mill

to do the job...better, faster, at lower cost!

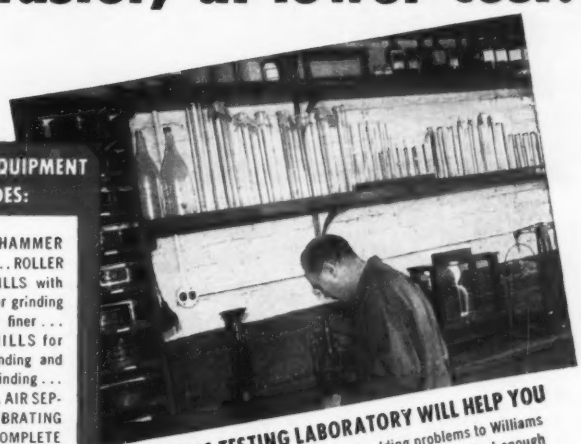
Whatever the material—mineral, vegetable, animal or chemical—you'll find a Williams Mill to crush, grind, shred or pulp it to exactly meet your most critical specifications. Of equal importance, and regardless of the size of the job, there's a size and type that will probably do it in one operation entirely without the need for additional or secondary equipment!

You get more for your investment too, when you choose a Williams! You'll find it more carefully designed, more ruggedly built, for year-after-year service. You'll find it offers the most in low-cost operation, in minimum maintenance, and in features that mean continuously stepped-up production. It will pay you to get *ALL* the facts!

WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 N. 9TH ST. ☆ ST. LOUIS 6, MO.

WILLIAMS EQUIPMENT INCLUDES:

HEAVY DUTY HAMMER MILLS, all sizes... ROLLER and IMPACT MILLS with Air Separation for grinding to 325 mesh or finer... HELIX-SEAL MILLS for fine dustless grinding and non-clog wet grinding... DRYER MILLS... AIR SEPARATORS... VIBRATING SCREENS... COMPLETE "Packaged" PLANTS, ready to install in existing buildings.



WILLIAMS TESTING LABORATORY WILL HELP YOU
Submit your grinding, crushing or shredding problems to Williams for solution—with neither obligation or cost. Simply send enough raw material for a test, and describe the result you want.

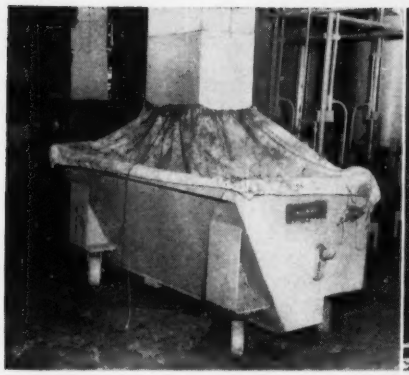
WILLIAMS

CRUSHERS GRINDERS SHREDDERS

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD

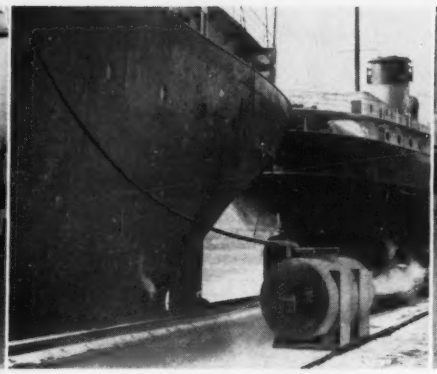
Here's *MASS-HANDLING* of bulk

What you see above is a Dempster-Dumpster serving one of its detachable containers. Multiply this simple pick up, haul and dump operation by scores of steel containers built to meet your requirements for handling waste or salvable materials, raw and finished products, fluids including acids, combustibles, dusty materials, etc. You have, then, mass-handling of bulk materials with one truck and one man!



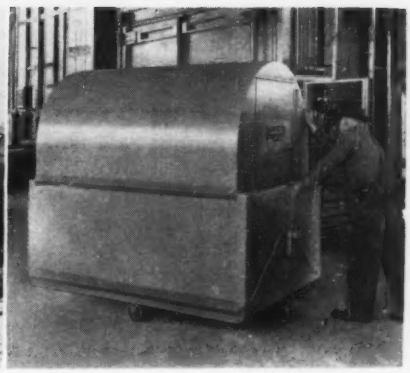
Tilt Type Container is handling filter dirt at a plant in Illinois. Note container is equipped with casters and placed under chute, through which the filter dirt passes directly from presses. As each container is filled, it is replaced with an empty one.

Three heavy duty Drop Bottom Type Containers, shown below, are loaded with cast iron fittings from conveyor at plant in Birmingham. Dempster-Dumpster picks up each container when loaded and hauls the finished products to shipping department.



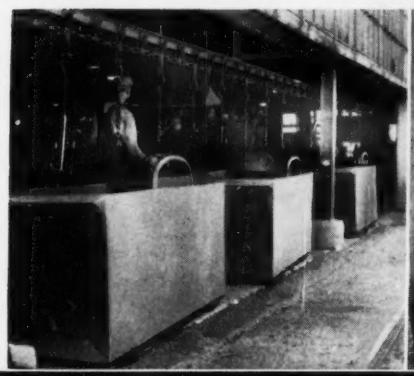
Tank Type Container is being filled with used oil from a ship. Time required to haul loaded container to reclaim station, drain and return for refilling—10 minutes. Time cycle of the former method using conventional barrels—60 minutes.

Here's another example of the many types of waste materials handled by this system. The Skip Type Container shown below is located under hydropulper at a paper plant. Picture was shot while container was being filled with rope waste sludge.



A loaded Apartment Type Container, equipped with roller bearing casters, is being rolled to outside of this plant building. Dempster-Dumpster will pick it up, haul to disposal area, dump the refuse and return empty container for refilling.

Waste materials are loaded into these Universal Containers at a food plant warehouse. Containers have lids in top, as well as a door in each end, which are opened to make deposits, then closed, sealing materials in container.



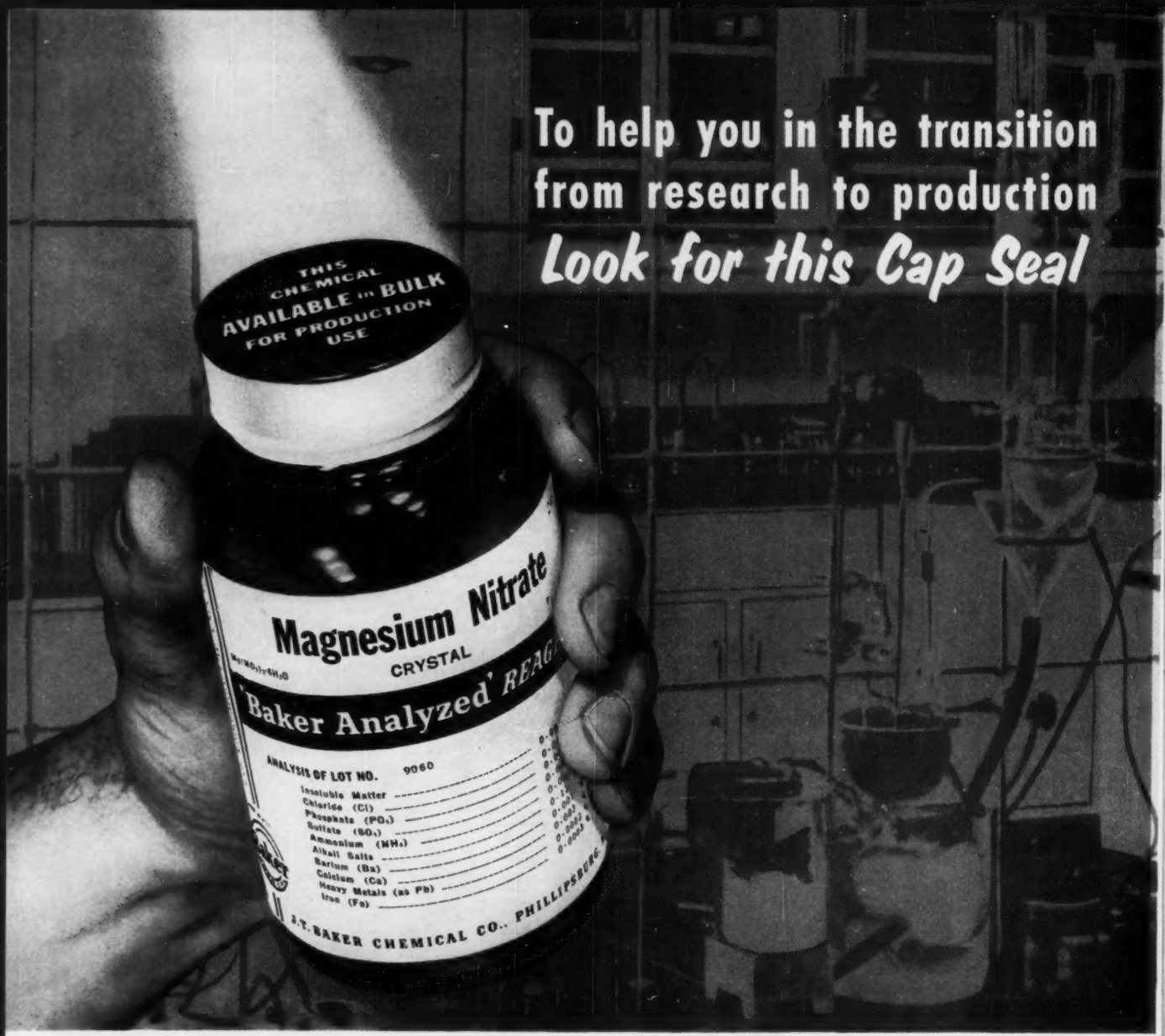
materials with one truck...one man!

A FEW OF THE HUNDREDS of containers available are shown above in actual service. They are built in capacities up to 21 cu. yds.—several times the capacity of the average dump truck body. One Dempster-Dumpster, operated by only one man, the driver, serves scores of big detachable containers, one after another—handling materials of every description. It's like having one truck with scores of bodies!

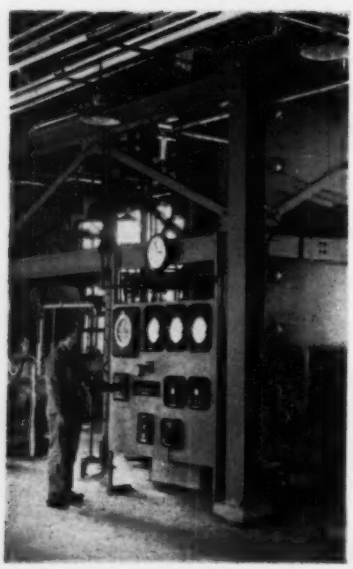
Records of performance in dozens of installations prove beyond question that savings are tremendous! The Dempster-Dumpster System cuts costs of equipment and operation. It is common knowledge that one Dempster-Dumpster will perform the work of several conventional trucks, reducing investment accordingly. This system eliminates standing idle time and re-handling of materials. Once placed in these containers, materials remain there until hauled to destination. Efficiency, sanitation and good plantkeeping are big advantages. Materials to be transferred or disposed of are constantly being placed in the containers as they accumulate. Containers for handling refuse are fire-proof, rat-proof and scavenger proof.

With no obligation on your part, our engineers will be glad to make a comprehensive fact-finding survey to determine the cost-cutting possibilities of this equipment in your plant. Write us for complete information today! Manufactured exclusively by Dempster Brothers, Inc.

DEMPSTER BROTHERS 295 Dempster Building, Knoxville 17, Tennessee



To help you in the transition from research to production *Look for this Cap Seal*



You're a step ahead when the purity and specifications of the laboratory chemicals used in your research are available in tonnage for process use. You can move confidently from laboratory and pilot studies to full commercial production.

More than 200 Baker laboratory chemicals are also supplied in tonnage quantities for production use. These chemicals in bulk quantities are economically priced, and their use frequently eliminates costly purification steps in your process.

Your research, development and production teams can quickly identify the Baker laboratory chemicals available in process quantities. A new cap seal will carry the statement "This chemical available in bulk for production use." Other Baker laboratory chemicals will be identified by a similar seal as their bulk applications become established.

You are already benefiting from the actual lot analyses and actual lot assays on the Baker label. This new cap seal is another "plus value"—a part of Baker's continuing program for more informative labelling of chemicals.

Baker laboratory chemicals play an important part in your research and development program. Let them help you translate your research success into a production success.

J. T. BAKER CHEMICAL CO.
Executive Offices, Phillipsburg, N. J.

Baker CHEMICAL

Baker Chemicals
REAGENT • FINE • INDUSTRIAL

To help you know the process chemicals Baker supplies in tonnage quantities...

Look at these Charts!

When you need process chemicals in tonnage quantities, the two charts reproduced on this page will show you, at a glance, many of the chemicals and grades supplied by Baker.

Each chart provides an easy-to-use, time-saving reference guide showing which light and heavy metal compounds are presently available *by the ton* or *by the carload.*

Like all Baker industrial chemicals, these metal compounds are products of precise Baker manufacturing skills. The controlled purity and uniformity of these chemicals—and their economy—make them the ideal choice for production use.

If chemicals you need are not listed, or if the required grade is not shown, perhaps we can produce to your specification. We are glad to do this when quantities are sufficient for economic manufacture.

Many of the chemicals on these charts are among the 200 Baker *laboratory* chemicals which bear the special cap seal reading *"This chemical available in bulk for production use."*

Baker can supply these LIGHT METALS (or cations) / IN THESE FORMS →	Ammonium	Sodium	Potassium	Magnesium	Calcium	Strontium	Barium	Lithium
Fluoride (Bifluoride)	R (Bi)	R	R		R	PR	R	TPR
Chloride	PR	PR	PR	TPR	PR	R	PR	TPR
Bromide	PR	PR	PR		P	P		P
Bromate		PR	PR					
Iodide	R	PR	PR		R			
Sulfide	TR	PR						
Sulfite (Bisulfite)	R (Bi)	PR	P					
Sulfate	PR	PR	PR	PR	R		R	TR
Bisulfate		R	TR					
Persulfate	PR		R					
Nitrate	TPR	PR	R	TPR	TPR	PR	TPR	TPR
Phosphate	PR	R	PR	P	R			
Carbonate	R	R	R	TPR	R	R	R	TPR
Bicarbonate	R	R	PR					
Thiocyanate	TPR	PR	TPR		P			
Acetate	PR	PR	PR	R	PR		PR	
Oxalate (Binoxalate)	PR		TPR (Bi)					
Borate	P	R	P					
Dichromate	PR		PR					
Molybdate	PR	TR						
Hydroxide	PR	PR	PR	P	PR	P	R	T
Miscellaneous		CYANIDE R; SALICYLATE PR; BISMUTHATE R; STANNATE R; TUNGSTATE R	FERRICYANIDE PR; FERROCYANIDE PR; CHROMATE PR	TRISILICATE P; OXIDE PR; SILICATE P				

KEY TO CHART: T—Technical Quality; P—Purified, U.S.P., or N.F. Quality; R—Reagent Quality. Black—Carloads; Grey—Tonnage

LIGHT METAL COMPOUNDS

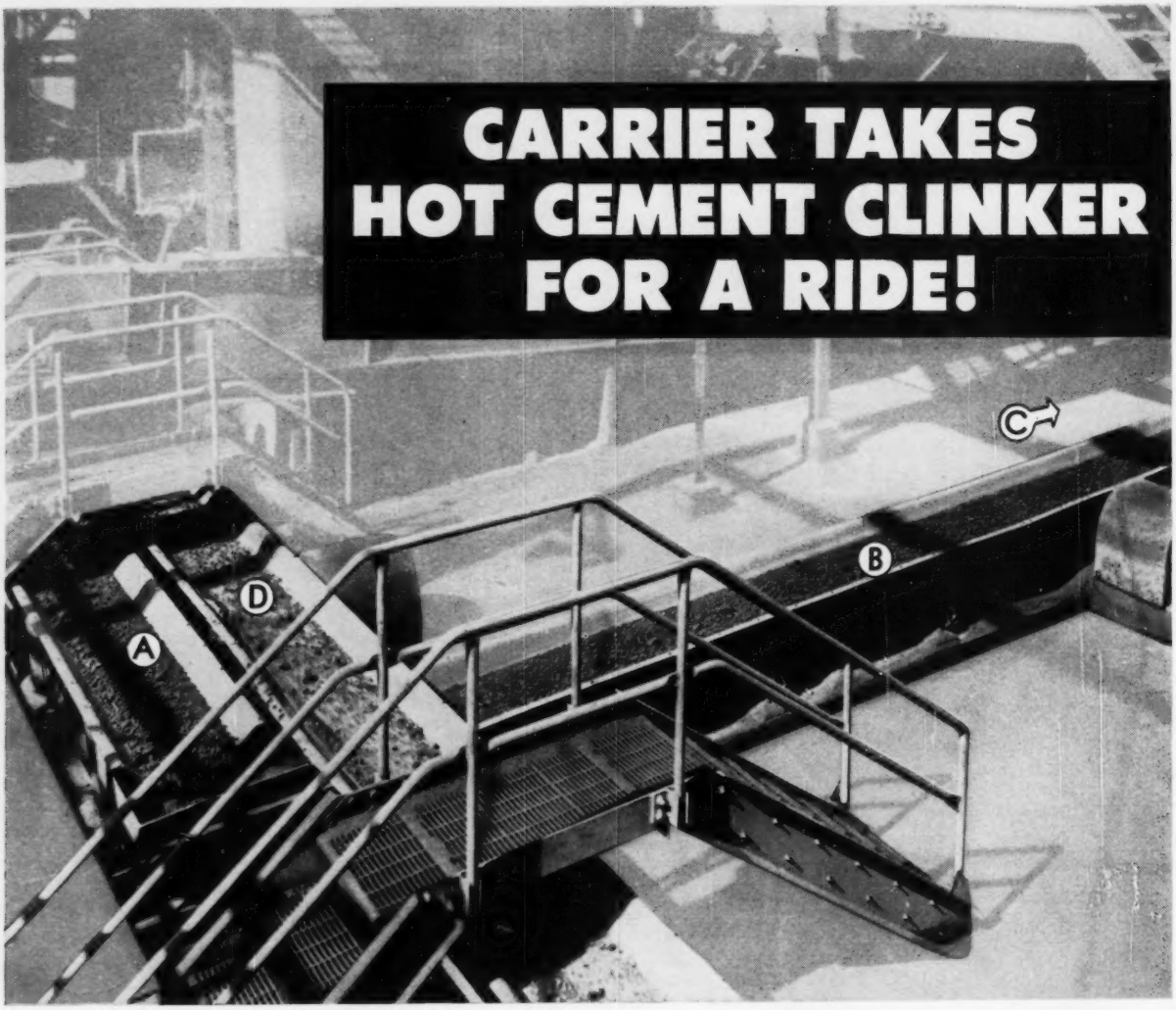
Baker can supply these METALS / in these forms →	Chloride	Bromide	Sulfate	Nitrate	Phosphate	Carbonate	Acetate	Chromate	Oxide	Miscellaneous	
Chromium	R		R	R			R		R	LIGHT METAL CHROMATES:	PR
Molybdenum									R	SODIUM & AMMONIUM MOLYBDATES:	TPR
Manganese	R		PR	R		R			PR		
Iron (Ferric)	R		R	PR						HYDROXIDE:	P
Iron (Ferrous)			PR							FERROUS AMMONIUM SULFATE:	PR
Cobalt	PR		PR	PR		R	R		R		
Nickel	PR		R	PR		R	R		R	NICKEL AMMONIUM SULFATE:	R
Copper	PR	R	R	TPR		R	R		R		
Zinc	PR	PR	PR	TR	P	R	TR	P	R		
Cadmium	PR		PR	R		R	R		R	IODIDE:	R
Mercury	PR		PR	PR			PR		TPR	IODIDE:	R
Aluminum	R		PR	TPR	P		R		R	HYDROXIDE:	PR
Tin (Stannic)	PR									SODIUM STANNATE:	R
Tin (Stannous)	TR								R		
Lead	TR		R	TPR		R	TPR	R	TPR	THIOCYANATE:	P
Bismuth	R			PR					R	OXYCHLORIDE:	R
Bismuth (Sub)				P		P				SUBGALLATE:	P

KEY TO CHART: T—Technical Quality; P—Purified, U.S.P., or N.F. Quality; R—Reagent Quality. Black—Carloads; Grey—Tonnage

HEAVY METAL COMPOUNDS

FREE Reference File—Baker Process Chemicals:

This convenient letter-size folder contains a complete set of availability charts and price schedules for Baker Process chemicals—keeps them at your finger tips. For your copy, write: J. T. Baker Chemical Co., Phillipsburg, N. J.



Carrier Conveyor "A" takes the clinker from coolers and feeds it at right angles onto the first of two other Carrier Conveyors "B" ("C" not shown) for delivery to a bucket elevator and storage.

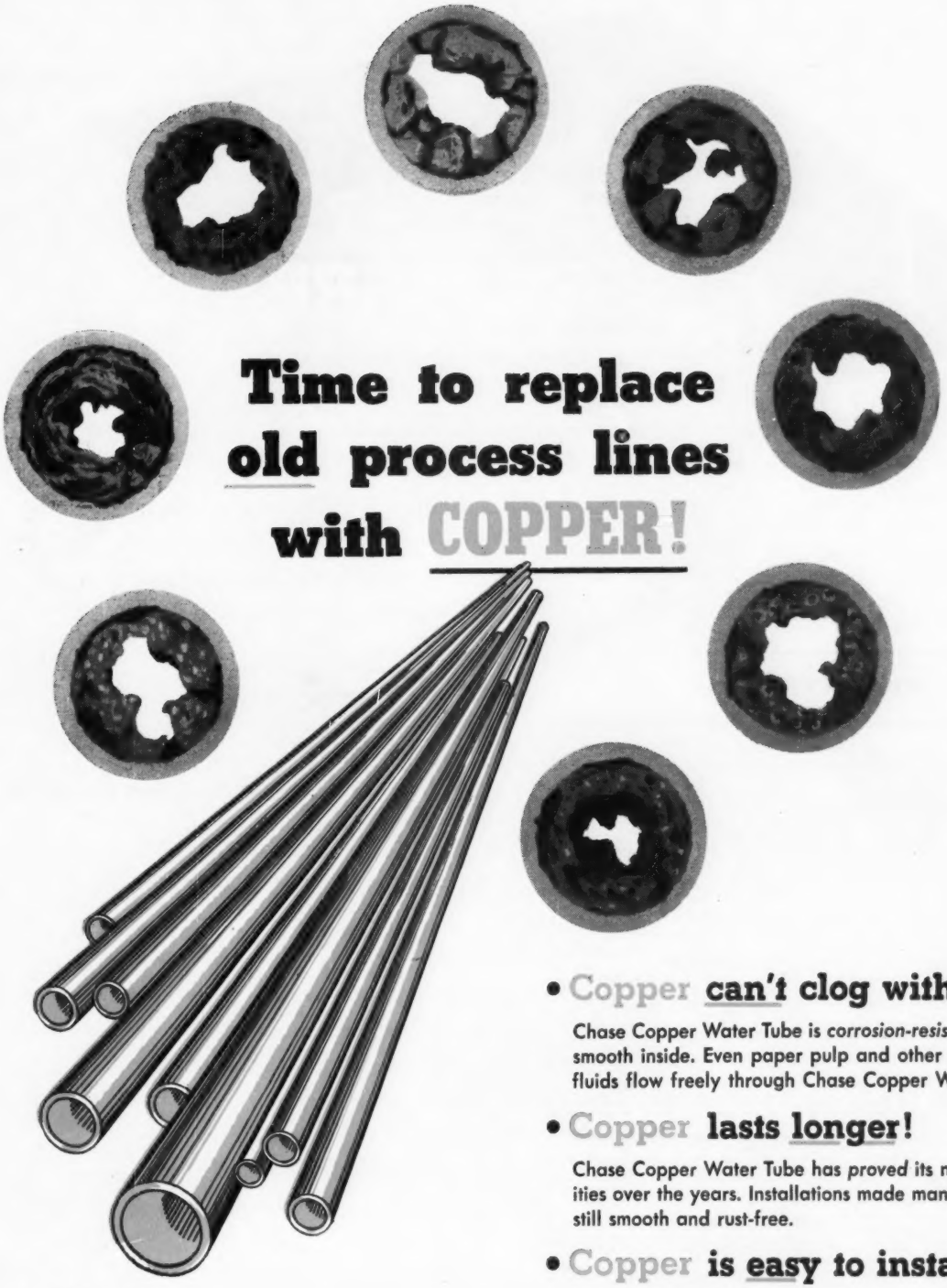
Carrier Conveyor "D" also takes the clinker from coolers, but conveys it directly to a different storage pit.
All four conveyors have 18" flared pans and 5HP drives, with a total length of 233'.

THAT'S hot cement clinker you see on those four Carrier Natural-Frequency Conveyors. It's being taken for a ride from coolers to two different storage pits. . . .

400° F. clinker is extremely abrasive — extremely tough to handle. Yet the Carrier Natural-Frequency Conveyors move it at the rate of 60 tons per hour with *a minimum of spillage, maintenance and downtime!*

Cement-industry applications are just one of many uses for Natural-Frequency Conveyors. Others include bulk chemicals, castings, ores, mill scale and slag, food products, machine turnings — all of which are now being conveyed and processed with spectacular success by Carrier Natural-Frequency vibrating equipment. Write for Bulletin 111. Carrier Conveyor Corporation, 243 North Jackson Street, Louisville 2, Kentucky.

CARRIER
~~NATURAL-FREQUENCY~~
CONVEYORS



Time to replace old process lines with COPPER!

• Copper can't clog with rust!

Chase Copper Water Tube is *corrosion-resistant*—clean and smooth inside. Even paper pulp and other heavy industrial fluids flow freely through Chase Copper Water Tube.

• Copper lasts longer!

Chase Copper Water Tube has proved its non-rusting qualities over the years. Installations made many years ago are still smooth and rust-free.

• Copper is easy to install!

Chase Copper Water Tube is light in weight, comes in long lengths that require fewer joints. You can make leak-proof, pressure-tight *solder-joints*, using simple, standard soldering techniques.

For more information, contact your nearest Chase Wholesaler or one of the Chase Warehouses listed below.

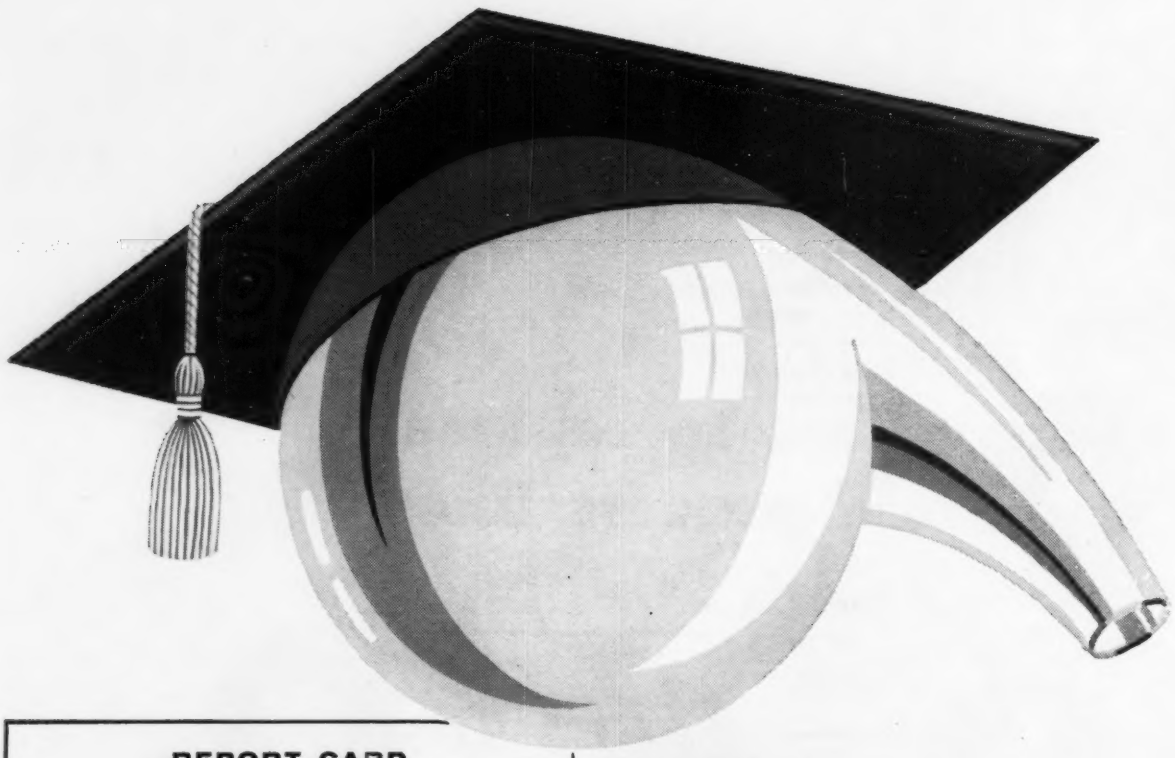
Chase®

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper (†sales office only)

Albany†	Chicago	Detroit	Los Angeles	New Orleans	Rochester†
Atlanta	Cincinnati	Grand Rapids†	Louisville†	New York	St. Louis
Baltimore	Cleveland	Houston	Milwaukee	Philadelphia	San Francisco
Boston	Dallas	Indianapolis	Minneapolis	Pittsburgh	Seattle
Charlotte†	Denver	Kansas City, Mo.	Newark	Providence	Waterbury



REPORT CARD

CO_2 as an Inert Gas for			
Pharmaceuticals	A	Pressure Transfer	A
Dyes	A	Fumigant Carrier	A
Paint	A	Capsulating	A
Lacquer	A	Explosives	A
Packaging	A	Powdering	A
Purging Tanks and Mains	A	Flushing Molten Metals	A
CO_2 as a Refrigerant for			
Pharmaceuticals	A	Resins	A
Dyes	A	Rubber Trimming	A
Paint	A	Vacuum Traps	A
Plastics	A	Low Temperature Testing	A
Lacquer	A	Explosives	A
Insecticides	A	Lyophilizing (LOW TEMPERATURE DRYING)	A
CO_2 as an Active Ingredient for			
Pharmaceuticals	A	Foam Plastic	A
Tin Plate Testing	A	Foam Rubber	A
Asbestos Cement Cure	A	Water Treatment	A
Carbonation	A	Manufacture of Carbonates	A
PH Control	A		

CO_2 ...POST-GRADUATE

CO_2 is an old "wonder chemical" — though not too old to learn . . . to expand its knowledge and usefulness. Today, the chemical and process industries are putting CO_2 to work in ways that were unheard of a few years ago. Here is a report card showing where CO_2 has been getting straight A's. We would be glad to discuss related applications in your processing methods and to place our wide experience at your disposal.

AT THE FRONTIERS OF PROGRESS YOU'LL FIND

PURECO

AN AIR REDUCTION PRODUCT

Pure Carbonic Company

Nation-wide "Dry-Ice" Service-Distributing Stations in Principal Cities

GENERAL OFFICES: 60 EAST 42ND STREET, NEW YORK 17, NEW YORK

PURE CARBONIC COMPANY *is a division of* **AIR REDUCTION COMPANY, INCORPORATED** *Principal products of other divisions include:* **AIRCO** *—industrial gases, welding and cutting equipment and acetylenic chemicals* **OHIO***—medical gases and hospital equipment* **NATIONAL CARBIDE***— pipeline acetylene and calcium carbide* **COLTON CHEMICAL COMPANY***— polyvinyl acetates, alcohols and other synthetic resins.*

Whether you prefer to lease or buy — you'll find the new ACF built DURADOME is designed to move your liquid products more efficiently. For only DURADOME is improved *four* ways:

- **Dome base flued from top center section — provides greater strength and a smooth interior for easier cleaning... better application of lining.**
- **All tanks are of pressure-type construction (complete ring sections). This means heavier gauge steel *all* the way around for greater protection of costly ladings.**
- **Standardized all-welded underframe provides flexibility of use with tanks of *all* standard types and capacities... more economical maintenance.**
- **All-welded heavy gauge insulation jacket with one-piece ellipsoidal heads provides maximum insulating efficiency... streamlined appearance... virtually maintenance-free life.**

Whatever your tank car requirements are—contact your nearest Shippers' Car Line representative—for prompt service through a nationwide organization.

SYMBOL OF THE FINEST IN TANK CARS

Specialists for over 35 years in the leasing, operation, maintenance and servicing of tank car fleets—also exclusive sales agent of ACF tank cars for industry.

SHIPPERS' SHPX CAR LINE

Shippers' Car Line Corporation

A subsidiary of ACF INDUSTRIES, Incorporated

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CHICAGO, ILL. • HOUSTON, TEX. • SAN FRANCISCO, CAL. • MILTON, PA. • EAST ST. LOUIS, ILL. • SMACKOVER, ARK. • TULSA, OKLA. • NORTH KANSAS CITY, MO.

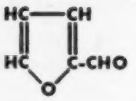
do you have the answers on

QO®

FURFURAL chemicals?

do you

QO Furfural



. . . represents a source of open chain compounds, such as adiponitrile, needed for nylon?

. . . acts as a highly selective solvent in refining lubricating oils, wood rosins and vegetable oils?

. . . is a reactive solvent, not only dissolving, but also reacting with, many resins?

. . . imparts long-flow properties to phenolic molding powders?

. . . is the principal extractive distillation agent used in the purification of butylenes and butadiene?

CHEMICAL INTERMEDIATE

PETROLEUM

RESINS

PHARMACEUTICALS

SYNTHETIC RUBBER

PLASTICIZERS

DYES

ABRASIVES

SYNTHETIC TEXTILES

ROSIN

WEED KILLERS

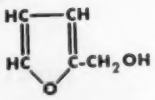
BRAKE LININGS

CHEMICAL CEMENTS

QO FURAN CHEMICALS®

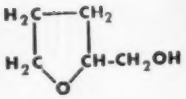
know that...

QO Furfuryl Alcohol



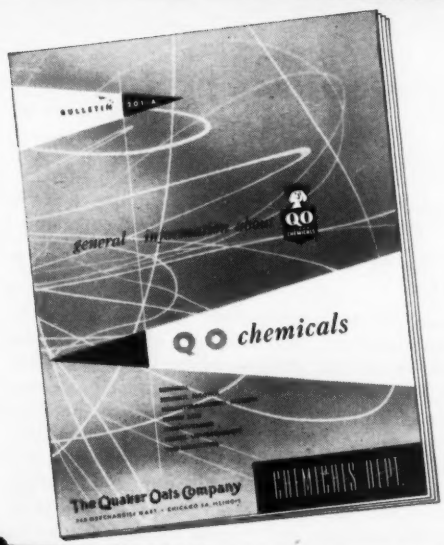
- ...readily resinifies when catalyzed by acidic reagents to form resins resistant to acids, alkalies and solvents?
- ...easily disperses many difficultly soluble dyes?
- ...improves gap filling and craze resistant properties of urea resins?
- ...is useful as a chemical intermediate?
- ...dissolves as well as reacts with many resins?

QO Tetrahydrofurfuryl Alcohol



- ...offers a convenient starting point in preparing high boiling esters for plasticizers?
- ...reacts as a cyclic ether to yield useful intermediates, e.g., dihydropyran?
- ...is a solvent for difficultly soluble dyes, resins and cellulose esters?
- ...is useful commercially in preparation of weed killers?

Get the Facts Today on QO FURFURAL CHEMICALS



FIRST... Send for your copy of our Bulletin 201-A General Information about QO Chemicals; then, if you have specific problems, consult us for prompt practical help.

To help you get the right answers, Quaker Oats maintains an extensive technical library. If you will indicate the nature of your interest, appropriate material will be sent to you.

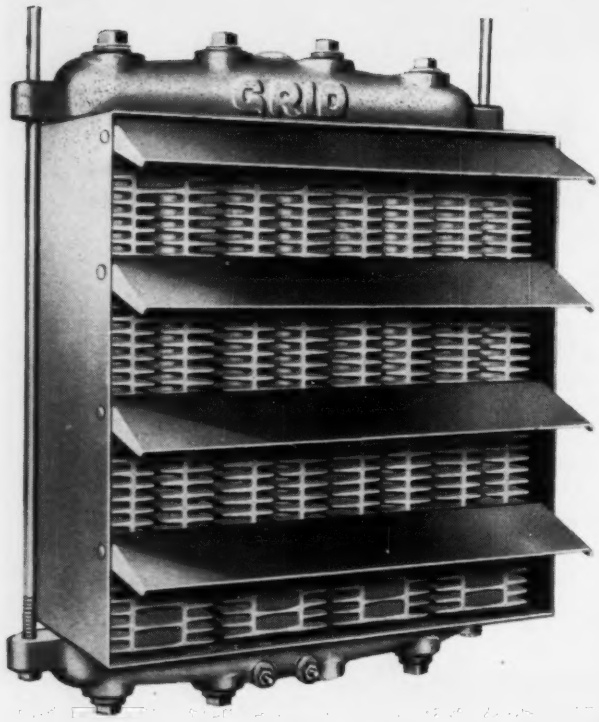
FRIENDLY SERVICE
A Quaker Oats Tradition

Furfural • Furfuryl Alcohol
THFA® (Tetrahydrofurfuryl alcohol) • Furoic Acid
Fur-Ag® Conditioner • Furafil® Lignocellulose

The Quaker Oats Company
CHEMICALS DEPT.

335C The Merchandise Mart, Chicago 54, Illinois
Room 535C, 120 Wall St., New York 5, N. Y.
Room 435C, P. O. Box 4376, Portland 8, Oregon

In the United Kingdom: Imperial Chemical Industries, Ltd., Billingham, England • **In Europe:** Quaker Oats-Graanproducten N.V., Rotterdam, The Netherlands; Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France; A/S "Ota", Copenhagen, S. Denmark
In Australia: Swift & Company, Pty., Ltd., Sydney • **In Japan:** F. Kanematsu & Company Ltd., Tokyo



hang 'em ...and forget 'em

GRID
UNIT HEATERS

Trouble-free heating service in the... **Major Chemical Plants** *since 1929*

ABBOTT LABORATORIES	HOFFMAN La-ROCHE INC.
AMERICAN CYANAMID	MATHIESON CHEMICAL CORP.
ANSUL CHEMICAL CO.	NATIONAL ANILINE
BUCKEYE COTTON OIL CO.	MONSANTO CHEMICAL CO.
CLIFFS DOW CHEMICAL CO.	NAUGATUCK CHEMICAL
BENZOL PRODUCTS	STAUFFER CHEMICAL
DOW CHEMICAL CO.	SHARPLES CHEMICALS
MERCK & CO., INC.	PHILLIPS PETROLEUM
HERCULES POWDER	UNION CARBIDE & CARBON
COLUMBIA SOUTHERN CHEMICAL CORP.	VICTOR CHEMICAL WORKS
DAVISON CHEMICAL CORP.	HOOKER ELECTRO-CHEMICAL
DIAMOND ALKALI CO.	GENERAL ANILINE &
E. I. DuPont de NEMOURS, INC.	GENERAL CHEMICAL DIV. ALLIED CHEM. & DYE CORP.
HARSHAW CHEMICAL CO.	

NO Maintenance or Repairs

The reasons for this wide acceptance . . .

GRID'S All-Cast construction having similar metals in contact with steam prevents electrolytic corrosion.

GRID'S ability to withstand steam pressures up to 250# P.S.I.

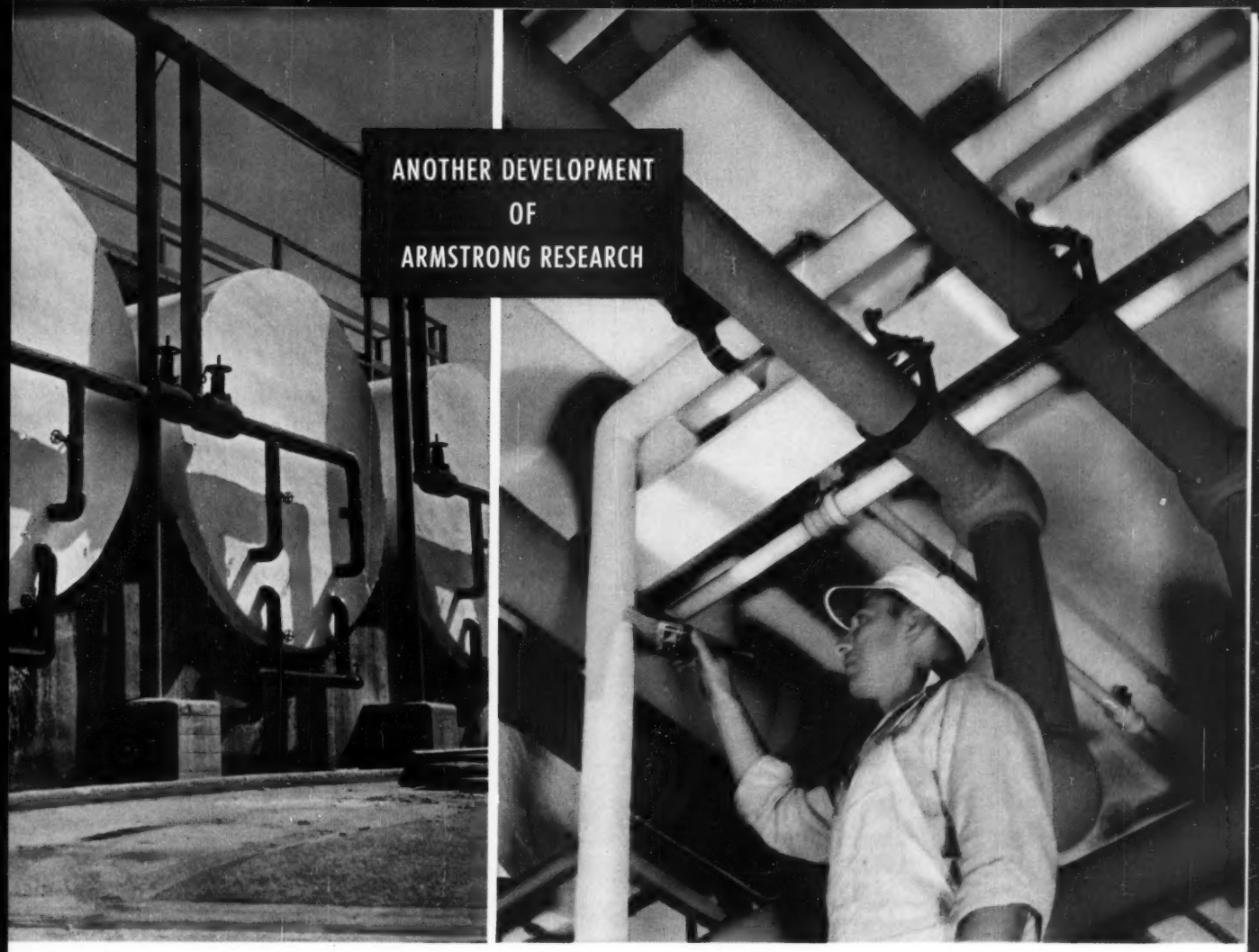
GRID'S low outlet temperatures, proper fan sizes and motor speeds assure delivery of warm comfortable air in ample volume, directly to the spot where it is needed. Maintenance cost conscious management men turn to GRID for relief from the continuous expense of heating failures experienced with ordinary unit heaters. GRID Unit Heaters installed in 1929 are still operating today . . . the only attention needed has been an occasional oiling of the motor. No ordinary unit heater can approach this record.

Get the full story today. Ask for booklet, CORROSION IN UNIT HEATERS . . . it's yours upon request.

D. J. MURRAY MANUFACTURING CO.

Manufacturers Since 1883 • WAUSAU, WISCONSIN

REPRESENTATIVES IN ALL PRINCIPAL CITIES



Insulcolor . . . *tough plastic finish protects and color codes insulated lines and tanks*

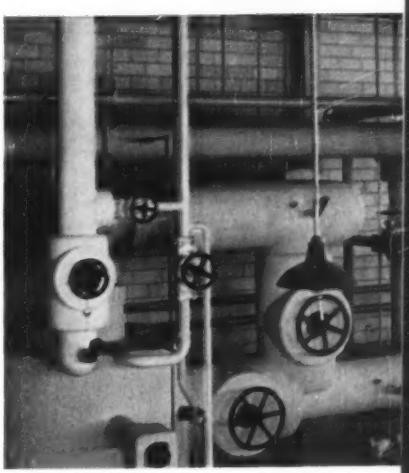
On both indoor and outdoor installations, you can be sure of long-lasting protection with this rugged insulation finish. And the durable plastic Insulcolor® coating not only protects insulated lines, tanks, vessels, ducts, and cold rooms, but serves as color identification, too.

Available in a choice of seven colors and white, Insulcolor furnishes a smooth, good-looking finish. It will withstand a wide range of temperatures and severe outdoor conditions without cracking, crazing, or peeling. Bumping or abrasion will not damage Insulcolor's tough plastic surface, and Armstrong Insulcolor is both fire resistant and moisture resistant, too.

Insulcolor is quickly and easily applied by brush or spray gun. An application lasts many years with little or no maintenance. Dirt, grease, and soot are readily washed off the smooth Insulcolor surface.

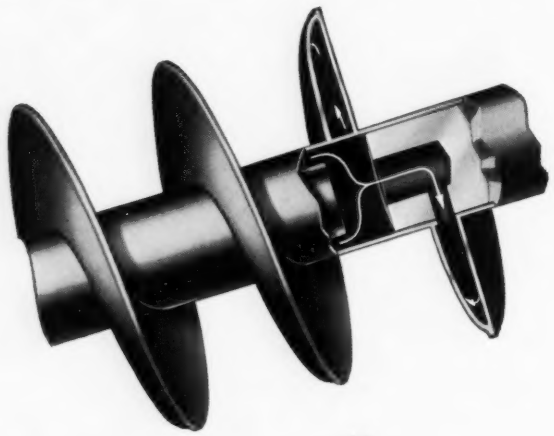
One of many products developed by Armstrong Research for the industrial insulation field, Insulcolor is readily available through the Armstrong Contract Service. Get full details on Insulcolor and the Armstrong Contract Service from your nearest Armstrong office. For your copy of the free 32-page booklet, "Armstrong Industrial Insulations," write today to Armstrong Cork Company, 209 Stratton Street, Lancaster, Pennsylvania.

Armstrong INDUSTRIAL INSULATIONS



Because Insulcolor color codes, as well as protects, it eliminates the bother and expense of stenciling or painting insulated lines with an identifying color after the finish has been applied.

A great new advancement in heat exchangers...

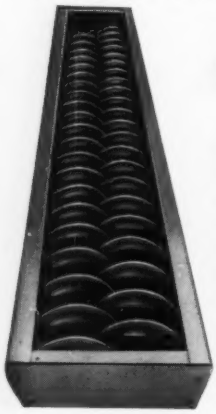


THE holo-flite* PROCESSOR
(HOLLOW-FLITE)

A simpler, more compact way to cool slurries, solids or pastes—in continuous flow!

Do you have processes where slurries, solids, pulps or pastes must be cooled or cooked? Do you know you can now handle such processes—*in continuous flow*—in as little as 1/5th the space required by other types of heat exchangers—and with many other important advantages?

The newly-developed HOLO-FLITE Processor is the answer!



what IT IS!

Basically the HOLO-FLITE consists of two or more flights of hollow-bladed screw conveyors. The product to be processed moves in a trough around the conveyor screws. The heat-transfer fluid circulates through the hollow blades and shafts of the conveyor. The product is constantly rotated into, around, under and over the blades and shafts through which the heat-transfer fluid is circulating, assuring quick, uniform heat passage between the two mediums—*as the product is continuously moved along in a bulk-flow without interruptions!*

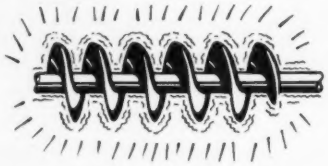
Get the complete story on HOLO-FLITE *savings and how this new advancement can simplify your processing operations. It is backed by the same organization that pioneered* COTTRELL *Precipitators and* MULTICLONE *Collectors—your assurance of complete dependability.*

DETAILED INFORMATION!
New 8 page bulletin describing HOLO-FLITE features and applications will gladly be sent on request. Write, wire or phone for your free copy!

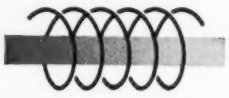
*Reg. T.M.

why IT'S BETTER!

The HOLO-FLITE principle provides many important advantages in modern processing operations...



ITS LARGE HEAT-TRANSFER SURFACE requires far less space—as little as 1/5th the space required by other heat-exchange equipment. Further, flights can be "stacked" as high as desired to save floor space, simplify installation!



ITS SLOW ROTATION IS SO GENTLE that granular and powdered solids are handled with no dusting—little or no particle abrasion. Result—no dust recovery problems . . . simple, inexpensive installation.

IT IS ADAPTABLE to a wide range of applications—handles solids, pulps, pastes and slurries with equal ease. Heat transfer agent can be refrigerant, water or other fluids to provide a wide range of temperatures. Cooled products can be packed directly from HOLO-FLITE discharge, saving time, space and additional handling.

IT CAN BE DESIGNED to handle virtually any capacity by varying the diameter and length of the flights, and the number of "tiers."

WESTERN
Precipitation
CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1023 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
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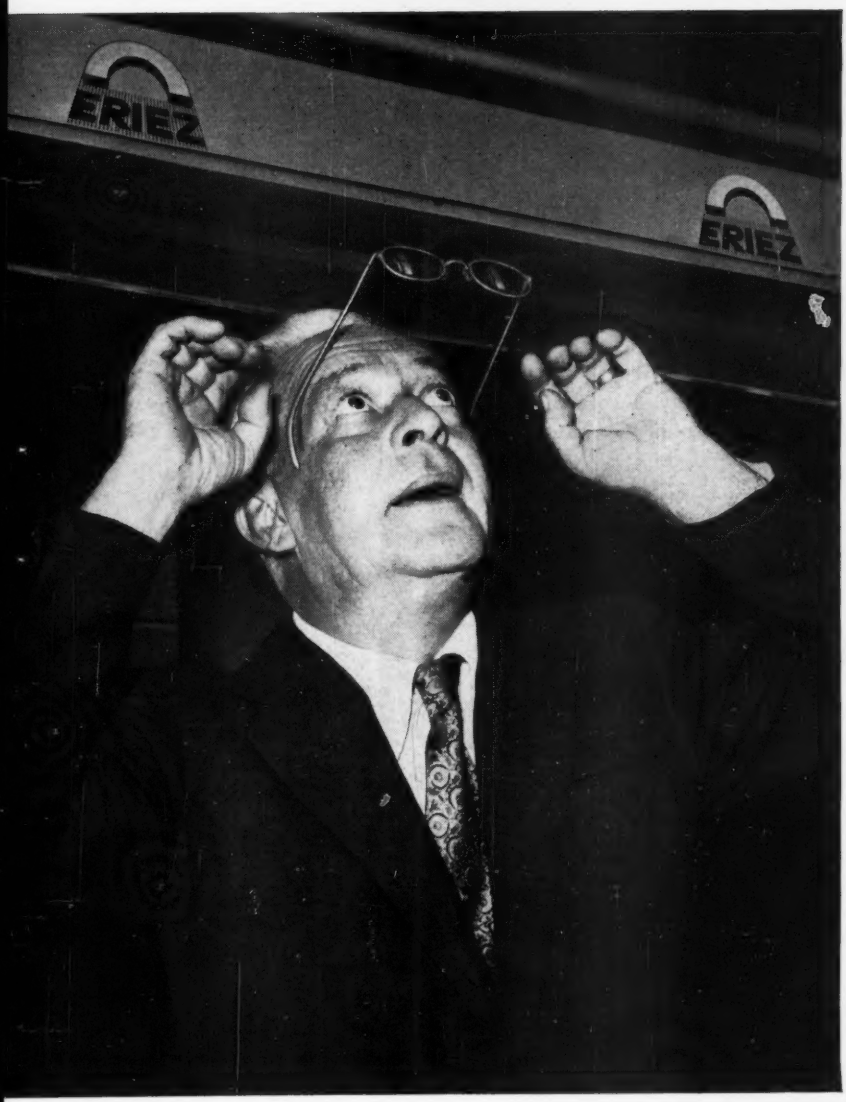
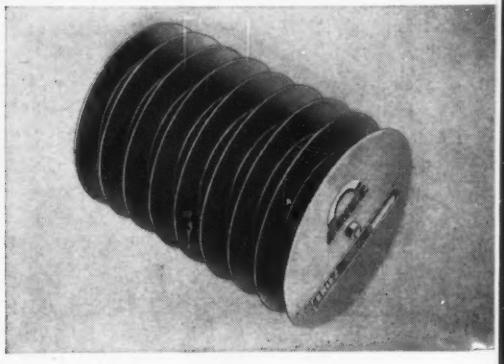
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL



EYE-POPPING POWER. Get close to a powerful Eriez Magnet and it will pull industrial goggles right off your nose, as Art Baker, popular TV personality demonstrates. The idea of a really powerful magnet has found a profitable application in American industry: separating tramp iron from processing lines . . . tramp iron which causes fires, machinery damage and product contamination. *All Eriez Magnets are non-electric, self-contained. They operate without any wires or attachments. Best of all their magnetic power lasts a lifetime.* The first cost is the last.

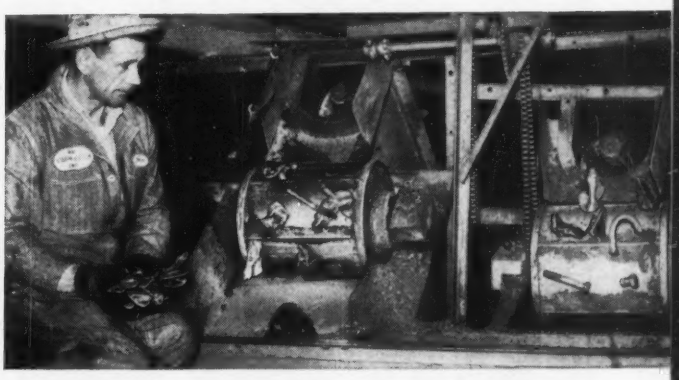


FURROWING THROUGH TRAMP IRON DANGER. The solution to removing tramp iron from free-flowing material in slope-shaped hoppers was found in a magnet which looks like a farm furrow. The Eriez Hopper Magnet consists of steel step-discs spaced in 1″ increments. Built in any width desired, this hopper magnet efficiently removes tramp iron which causes machinery damage, fires, and product contamination. Ideal for surge-fed application. Want more information on this product? . . . request Bulletin B-204.

MAGNETIC IDEAS FROM ERIEZ

Eriez "Magnetic Ideas" can help you. Eriez' factory-trained field men, backed by Eriez' laboratory and engineering know-how, will be happy to study your particular problem, make a plant survey and offer helpful "Magnetic Ideas". Write or call Eriez Manufacturing Company, 74X Magnet Drive, Erie, Pa.

PAPER MILL PROTECTS PUMPS. Two bucketfuls of tramp iron are removed every month by an Eriez Magnetic Pressure Hump in one of the East's largest plants making book and magazine grades of paper. This installation, in the line at the point following the beaters and ahead of the jordans, has proved to be the solution to pumps damaged by bailing wire, nails, and other forms of tramp iron found in the white water lines. Heretofore, pumps had to be serviced 4 or 5 times a week. It will pay you to get more information about this magnetic separator and the dozens of others that Eriez offers. Request new 16-page Catalog 17.



ROLLING DRUMS HALT METAL PARADE. Tramp iron stops when it reaches these Eriez Magnetic Drums installed at the Stappenbeck Rendering Co., Rochester, N. Y. Manufacturers of tallow, processed meat scraps, etc., the company uses the magnetic drums to remove all traces of metal from the finished product, and to prevent damage to costly screens and expellers. Previously, *because of metal damage*, screens had to be changed after 1 to 5 tons of material had passed over them. Now they're changed after screening 40 or 50 tons, and then only because they wear out, *not* because of tramp iron damage.

McLouth STAINLESS Steel

High quality stainless sheet and strip steel . . . for the product you make today and the product you plan for tomorrow.

McLouth Steel Corporation
DETROIT, MICHIGAN
Manufacturers of Stainless and Carbon Steels

DARCO Digest

CHEMICALS DIVISION
ATLAS POWDER COMPANY, WILMINGTON 99, DELAWARE
ATLAS POWDER COMPANY, CANADA, LTD., BRANTFORD, CANADA

Preventing haze in solutions by treatment with activated carbon

Trouble-producing impurities of marginal solubility can often be removed by activated carbon before they materialize.

Turbidity is generally caused by an ingredient that is at the point of precipitation when the solution is prepared, and later falls out of solution due to change in temperature, addition of other ingredients or some other action that lowers solubility below the critical point. Most floc-forming ingredients are large molecules . . . which are readily adsorbed by activated carbon.

Sugar, for example, frequently contains organic impurities that can cause haze. In carbonated beverages, this lack of clarity would often be detrimental to the acceptability of the finished product. The floc precursors may drop out of solution during carbonation. To make a sugar of the quality required by the beverage trade, many refiners use the Darco process in their manufacturing plant.

Beer is another product subject to haze formation. Certain nearly insoluble proteins in the beer will precipitate out during extended periods of cold storage. By giving the beer a small dosage of carbon in the "cellar" stage, these haze-formers are removed from the product and chill storage life is considerably improved.

If you have a haze problem in your product, let us have the details about it. We can probably give you recommendations on how to tackle the job with activated carbon.

Darco cuts loss of valuable products

Any time you're using activated carbon for purifying a valuable product, make sure you check on filter retention. Every activated carbon retains mechanically some of the treated product in the filter cake. Darco, however, holds less than other types of carbon.

For example, in purification of vegetable oils, for each 100 pounds of carbon in the filter cake you get 60 to 90 pounds more oil out of the filter when you use Darco. This difference adds appreciably to profit, for it greatly reduces an important source of product loss.

Darco activated carbons have many other qualities that add up to better efficiency of your filtering operations. We'd like to give you the story . . . just outline your specific problem and we'll send applicable data.

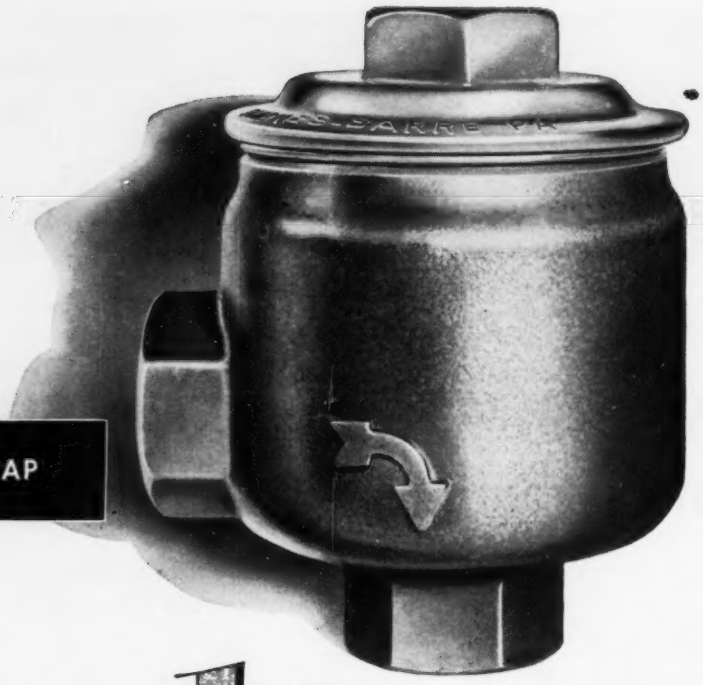
Crystal yield increased by carbon treatment

The yield of product recovered from solution by crystallization frequently suffers from the presence of impurities. When crystallization inhibitors are in the mother liquor, only part of the product is crystallized out.

Colloids are typical of the kind of materials that reduce crystal yield. By treatment with activated carbon, these impurities are physically removed from solution.

An example of this technique is in the refining of sugar. Carbon treatment, intended primarily to decolorize, also takes out melassagenic impurities that impede crystallization. The result is an improvement in yield of crystalline sugar at the vacuum pans.

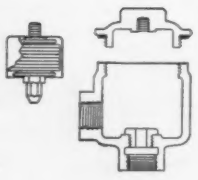
This basic idea is a good one to follow: when recovering a crystalline product from solution, make the mother liquor as pure as possible before crystallization, especially if you recycle the mother liquor...and you will obtain maximum crystal yield. Darco activated carbon is an excellent purifying agent for such applications. Write to us about your own recovery process, and we'll be glad to lend a hand. We're specialists in the use of carbon, and we can probably help you.



STEAM TRAP

Quality

Just 3 quality parts—thermostatic bellows, body, cap. Simple, positive action. Won't leak!



Nicholson quality . . . that gives you the extra strength, extra capacity, extra *stamina* required for severest chemical processing service. Nicholson quality pays off, when it comes to discharging condensate and air from steam lines . . . most efficiently, dependably, economically.

- **Powerful valve action—big husky bellows.**
- **Positive shut-off—finely ground valve and seat.**
- **High capacity—large diameter orifice.**
- **Rigidly tested—on actual steam lines.**

When less than best won't do, specify Nicholson. Send for *Catalog 953*.

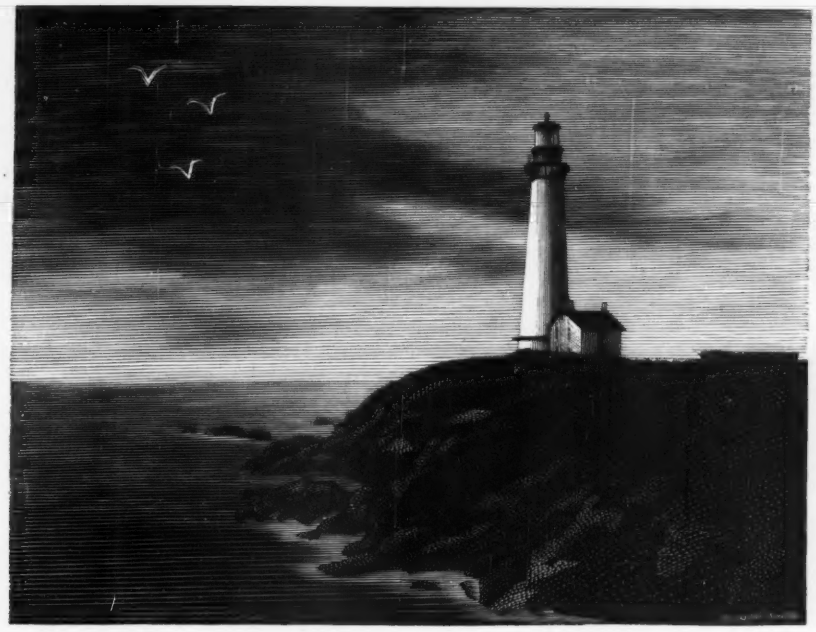
NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 58 PRINCIPAL CITIES

FAMOUS LIGHTHOUSES OF AMERICA



PIGEON POINT LIGHTHOUSE is located on the Coastal Highway 5 miles south of Pescadero, California. Constructed in 1872, its 115-foot white masonry tower stands on a rocky headland that for many years has been a landmark for ships approaching the Golden Gate from the south. Pigeon Point and the lighthouse are named for the ship Carrier Pigeon, one of the many that came to grief on the outlying rocks in the years before the beacon was built.

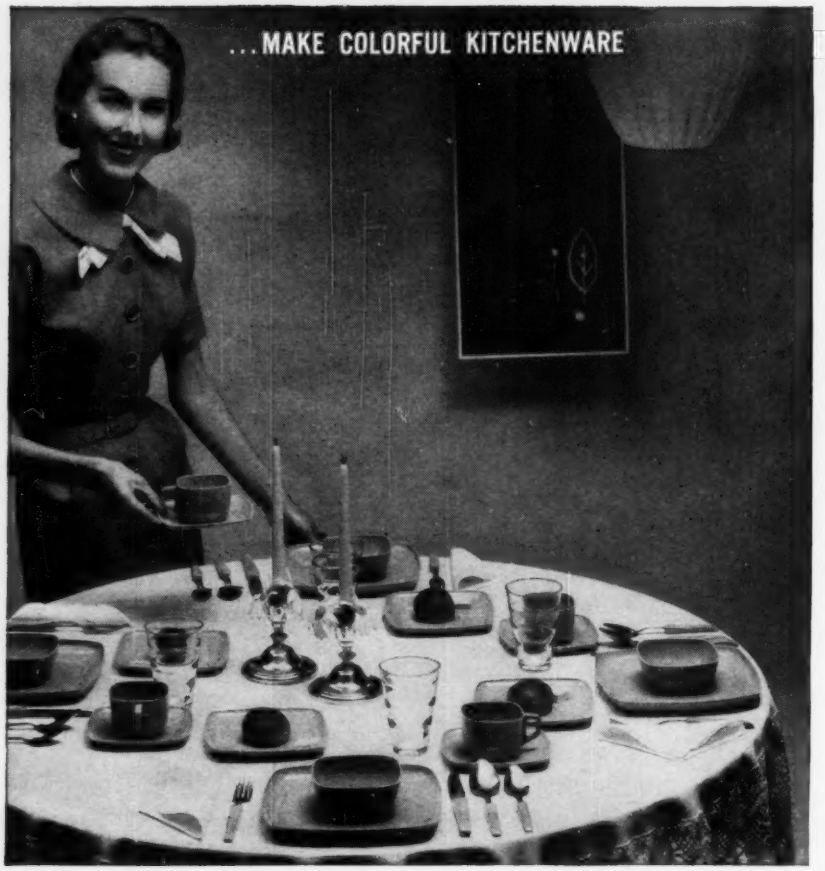
Safe Guides to quality in electrochemicals are Niagara Alkali Company's skill and experience in production and its modern facilities for quality control. Put your trust in Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Paradichlorobenzene, Nialk Caustic Soda, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride).

NIAGARA ALKALI COMPANY

60 East 42nd Street

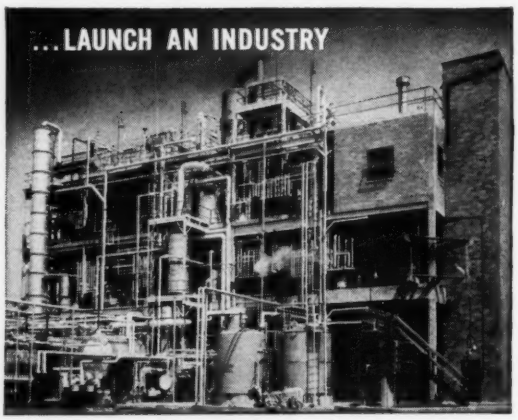
New York 17, N.Y.

HOW HERCULES HELPS...



EXCITING NEW DISHES AND CUTLERY, both molded with a new Hercules plastic, Hercocel® W, are as durable as they are beautiful. A product of Hercules research, Hercocel W is a low-cost thermoplastic combining high heat resistance and good dimensional stability with exceptional toughness and impact strength. (Tranquil ware dishes by Byrd Plastics, Inc.; cutlery by Royal Brand Cutlery Company, a Division of National Silver Company, Brooklyn, New York.)

HANDY CONTAINERS and display rack for Hercules smokeless powders work two ways—they make it easier for the sportsmen who do their own loading to select the right powder, and convenient for the dealer to arrange an eye-catching display. Hercules powders have long been the favorite with handloaders who want accuracy and economy.



A MILLION POUND A MONTH PLANT is now producing dimethyl terephthalate at Burlington, N. J. Largest single user: Canadian Industries (1954) Ltd., in the synthetic fiber 'Terylene'. Hercules' plant, first to make DMT by air oxidation, is designed to expand as markets grow.

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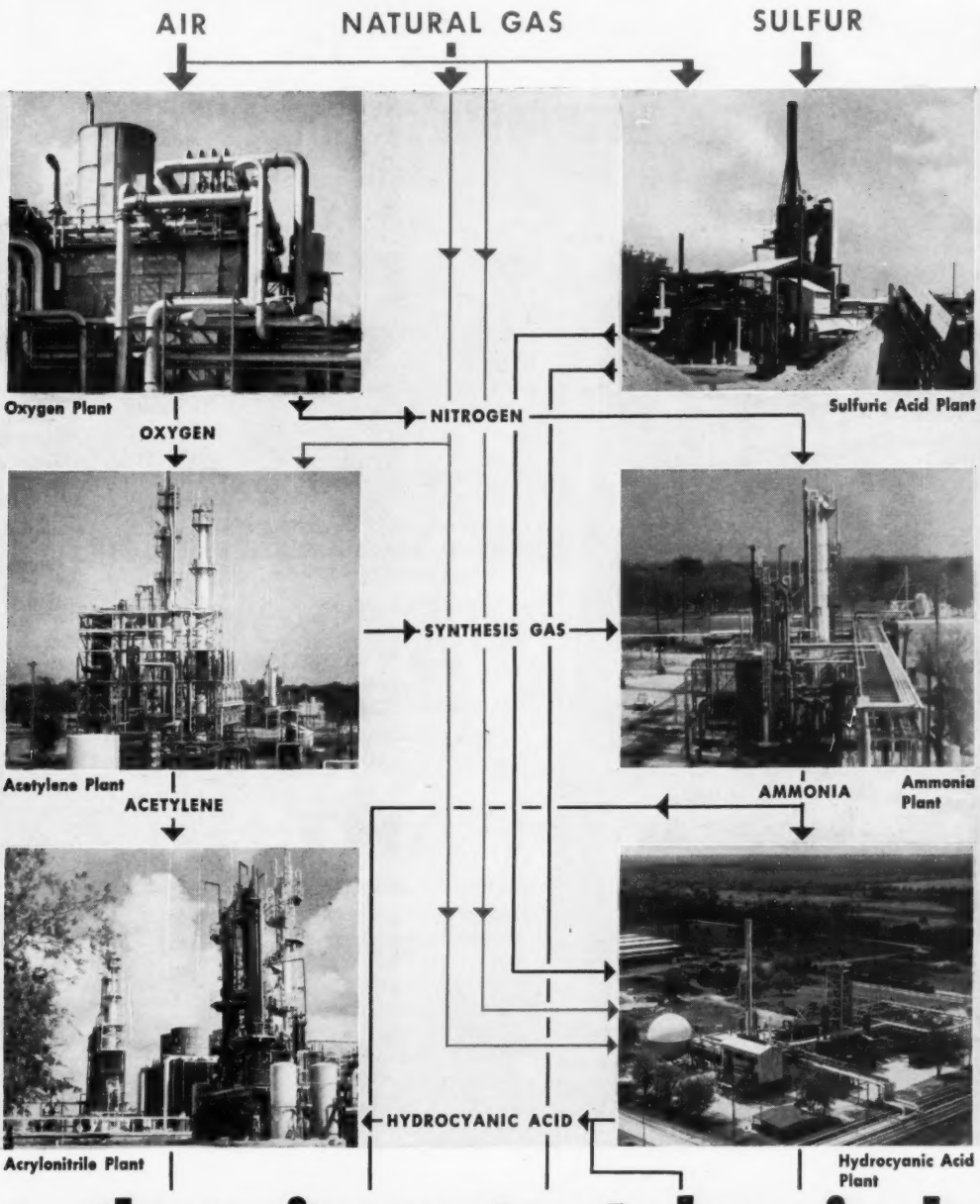
CHEMICAL MATERIALS FOR INDUSTRY

From these raw materials...



to these important chemicals

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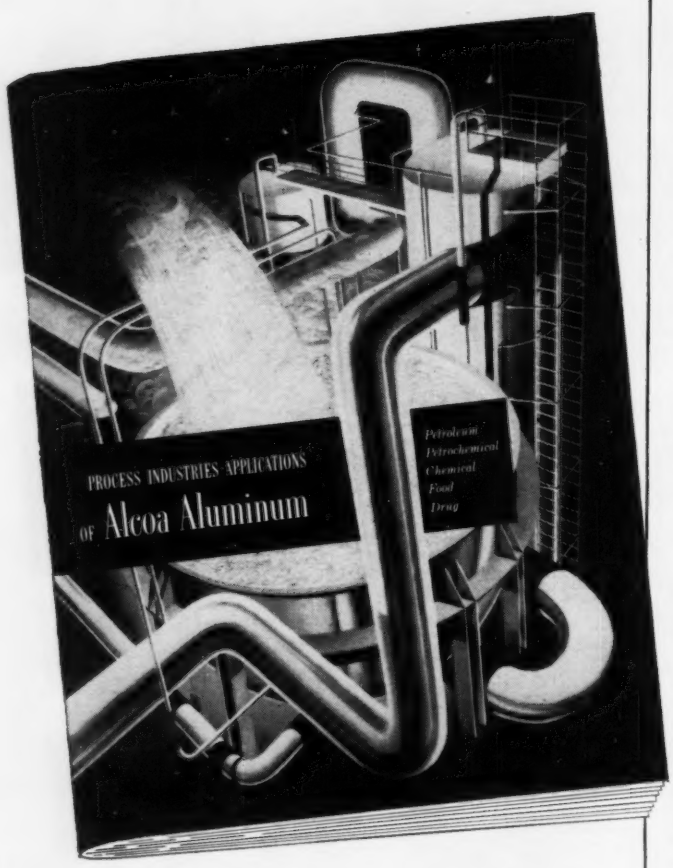

PART 1

PROCESS INDUSTRIES APPLICATIONS

Typical Applications
Organic Chemicals
Inorganic Chemicals
Petroleum and Petrochemical
Food, Drug, Beverage
Plant Atmospheres
Advantages of ALCOA Aluminum
ALCOA Alloys Available
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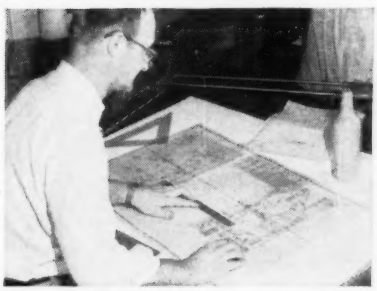

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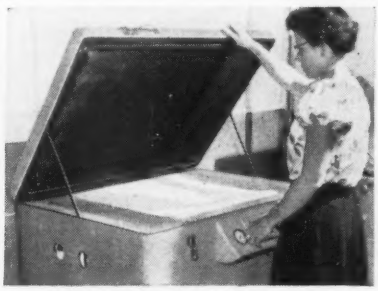

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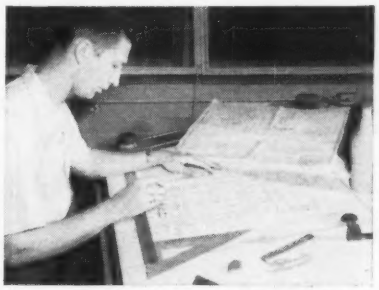

New design is added to the Autopositive, which has dense photographic black lines on a clean white translucent base. Required number of shop prints—each crisp and uniform—are produced from this master, which can also be used later on for minor revisions.

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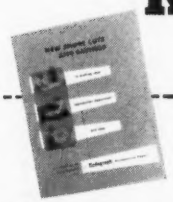

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CAUTION: Do not use table without reading text.

	Asbestos			All Rubber						Misc.
	Compressed sheet	Woven rubber	Woven neoprene	GR-S	Neoprene	Buna-N	Butyl	Natural	Plant-fiber sheet	Teflon
Acetic acid, crude	C	C	A	C	F	F	F	C	F	A
pure	C	C	A	C	F	F	F	C	F	A
vapors	C	C	A	C	F	F	F	C	F	A
150 p.s.i., 400 deg. F.	F	C	–	X	F	F	X	X	X	A
Acetic anhydride	–	C	A	–	–	–	–	–	–	A
Acetone	A	A	X	A	C	X	A	F	C	A
Acetylene	A	A	–	A	C	A	A	A	C	A
Air	A	A	A	A	A	A	A	A	A	A
Aluminum chloride	A	A	A	A	A	A	A	A	–	A
Aluminum fluoride	–	A	–	–	–	–	–	–	–	A
Aluminum sulphate	–	A	A	A	A	A	A	A	–	A
Alums	A	A	C	A	A	A	A	A	–	A
Ammonia gas, cold	A	A	A	A	A	A	A	A	A	A
hot	A	A	–	C	A	C	C	C	X	A
Ammonium chloride	A	C	A	–	A	–	A	A	F	A
Ammonium hydroxide	A	A	A	C	C	C	A	C	A	A
Ammonium nitrate	–	C	F	A	A	A	A	A	–	A
Ammonium phosphate, monobasic	–	C	A	A	A	A	A	A	–	A
dibasic	–	A	A	A	A	A	A	A	–	A
tribasic	–	A	A	A	A	A	A	A	–	A
Ammonium sulphate	A	C	A	A	A	A	A	A	–	A
Amyl acetate	A	A	C	X	X	X	–	F	C	A
Amyl alcohol	A	A	C	A	A	A	A	A	A	A
Aniline, aniline oil	A	A	–	X	F	X	A	A	X	–
Aniline dyes	A	A	–	F	F	F	A	A	F	–
Asphalt	F	A	–	X	F	F	A	X	X	F
Barium chloride	A	C	A	A	A	A	A	A	–	A
Barium hydroxide	A	A	A	A	A	A	A	A	F	A
Barium sulphide	–	A	–	A	A	A	A	A	–	A
Beer	A	A	X	A	A	X	A	A	A	A
Beet sugar liquors	A	A	A	A	A	A	A	A	A	A
Benzene, benzol	C	A	X	X	X	X	X	X	A	A
Benzine, petroleum ether, naphtha	C	A	X	X	X	X	X	X	A	A
Black sulphate liquor	A	A	–	A	A	A	A	A	X	A
Blast furnace gas	C	A	–	C	C	F	C	C	X	A
Borax	A	A	A	A	C	F	A	A	A	A
Boric acid	–	A	A	A	A	A	A	A	–	A
Bromine	X	X	X	X	X	X	X	X	X	A
Butane	A	A	–	X	F	C	–	F	X	A
Butyl acetate	A	A	X	X	X	X	F	X	X	A
Butyl alcohol, butanol	A	A	C	A	A	A	A	C	X	A
Calcium bisulphite	C	C	A	C	–	–	C	A	–	A
Calcium chloride	A	C	A	A	A	A	A	A	A	A
Calcium hydroxide	A	A	A	A	A	A	A	A	F	A
Calcium hypochlorite	A	C	A	C	C	A	A	C	F	A
Caliche liquors	–	C	–	–	A	A	A	A	–	A
Cane sugar liquors	A	A	A	A	A	A	A	A	F	A
Carbolic acid, phenol	–	A	C	X	C	X	X	X	–	A
Carbon dioxide, dry	A	A	–	A	A	A	A	A	X	A
wet	A	A	–	A	A	A	A	A	X	A
Carbon bisulphide	A	A	–	X	X	X	X	X	X	A
Carbon monoxide, hot	A	A	–	C	C	C	C	C	C	A
Carbon tetrachloride	F	A	X	X	X	X	X	X	C	A
Castor oil	A	A	X	A	A	A	A	A	A	A
China wood oil, tung oil	A	A	X	X	F	A	–	X	C	A
Chlorine, dry	F	A	X	F	F	F	F	A	X	A
wet	F	X	X	F	F	F	F	F	X	A
Chlorinated solvents, dry	C	A	X	X	X	C	X	X	X	A
wet	C	A	X	X	X	C	X	X	X	A
Chloroacetic acid	–	X	X	–	–	–	–	–	–	A
Chlorosulphonic acid	C	X	X	X	X	X	X	X	X	A
Chromic acid	C	X	X	X	X	X	C	X	C	A
Citric acid	C	C	A	F	A	F	C	A	F	A
Coke oven gas	A	A	–	C	C	A	C	A	X	A
Copper chloride	A	C	A	A	F	A	F	A	–	A
Copper sulphate	A	C	A	A	A	A	F	A	A	A
Corn oil	A	A	X	X	F	A	A	X	C	A
Cotton seed oil	A	A	X	X	F	A	A	X	X	A
Creosote, coal tar	A	A	–	X	F	A	X	X	X	A
wood	C	A	X	X	F	A	X	X	X	A
Cresols, cresylic acid	–	A	X	X	X	F	X	X	–	A
Dowtherm, A	C	A	X	X	X	X	X	X	X	A
E	C	A	X	X	X	X	X	X	X	A
Ethers	A	A	X	C	C	C	F	X	X	A
Ethyl acetate	A	A	X	F	X	X	F	F	A	A
Ethyl cellulose	F	A	–	F	F	F	A	F	X	A
Ethyl chloride	A	A	–	A	A	A	A	A	C	A
Ethylene glycol	A	A	–	A	A	A	A	A	A	A
Ferric chloride	–	C	C	A	A	A	A	A	–	A
Ferric sulphate	–	C	C	A	A	A	A	A	–	A
Formaldehyde	C	A	C	A	C	A	A	A	F	A
Formic acid	–	X	C	A	X	X	A	A	–	A
Freon	C	A	–	X	F	F	F	X	C	A
Fuel oil	A	A	–	X	F	A	X	X	X	A
Fuel oil, acid	–	A	–	–	–	–	–	–	–	A
Furfural	C	A	–	X	X	X	–	X	X	A
Gasolene, sour	–	A	–	X	A	A	X	X	–	A
refined	C	A	–	X	A	A	X	X	X	A
Gelatin	A	A	A	A	A	A	A	A	A	A
Glucose	A	A	A	A	A	A	A	A	A	A
Glue	A	A	A	F	A	A	F	A	C	A
Glycerin, glycerol	A	A	C	A	A	A	A	A	A	A
Green sulphate liquor	A	A	–	A	A	A	A	A	X	A
Hydrobromic acid	–	C	–	X	–	–	–	A	–	A
Hydrochloric acid, <150 deg. F.	F	C	A	F	F	A	A	A	–	A
>150 deg. F.	X	C	C	X	F	X	–	F	–	A
Hydrocyanic acid	–	A	–	–	–	–	–	–	–	A
Hydrofluoric acid, cold, <65%	X	X	–	F	A	–	F	F	X	A
>65%	X	X	–	X	X	X	C	X	X	A
hot, <65%	X	X	–	C	A	–	C	C	X	A
>65%	X	X	–	C	C	–	C	C	X	A
Hydrofluosilicic acid	A	X	–	A	F	A	A	A	X	A
Hydrogen gas, cold	A	A	–	F	A	A	A	F	C	A
hot	A	A	–	F	A	A	A	F	C	A
Hydrogen peroxide	–	A	X	F	A	–	F	F	–	A
Hydrogen sulphide, dry, cold	–	A	X	C	F	C	A	C	–	A
hot	–	A	X	C	F	C	A	C	–	A
wet, cold	–	A	X	C	F	C	A	C	–	A
hot	–	A	X	C	F	C	A	C	–	A
Kerosene	A	A	X	C	F	A	X	C	C	A
Lacquers	C	A	X	X	X	X	X	C	X	A
Lacquer solvents	C	A	X	X	X	X	X	C	X	A
Lactic acid, cold	A	A	A	C	C	F	A	C	C	A
hot	A	C	A	C	C	F	A	C	C	A
Linseed oil	A	A	C	F	A	A	X	F	C	A
Lubricating oils, sour	A	A	C	F	A	A	X	F	C	A
refined	A	A	C	F	A	A	X	F	C	A
Magnesium chloride	A	C	C	A	A	A	A	A	C	A
Magnesium hydroxide	A	A	C	C	A	C	C	C	C	A
Magnesium sulphate	–	C	C	A	A	A	A	A	–	A
Mercuric chloride	–	C	C	–	–	–	–	–	–	A
Mercury	C	A	–	–	–	–	–	–	–	A
Methyl alcohol, methanol	A	A	C	A	C	A	A	A	C	A
Methyl chloride	C	A	–	C	C	C	A	C	–	A
Milk	–	A	X	A	F	A	A	C	–	A
Mineral oils	A	A	X	C	F	A	A	C	C	A
Natural gas	A	A	–	C	F	A	A	C	–	A
Nickel chloride	–	C	A	A	A	A	A	A	–	A
Nickel sulphate	–	C	A	A	A	A	A	A	–	A
Nitric acid, crude	C	X	X	X	X	X	C	A	–	A
diluted	C	X	X	X	X	X	A	X	–	A
concentrated	X	X	X	X	X	X	C	X	–	A
Nitrobenzene	–	C	–	X	X	C	X	X	–	A
Oleic acid	A	A	–	F	A	A	F	A	–	A
Oleum spirits	–	X	X	–	–	–	–	–	–	A
Oxalic acid	A	X	A	F	–	–	–	F	C	A
Oxygen, cold	A	A	–	C	A	C	–	C	C	A
<500 deg. F.	C	A	–	C	C	C	–	C	X	X
500–1,000 deg. F.	–	A	–	–	–	–	–	X	–	X
>1,000 deg. F.	X	X	–	X	X	X	X	X	X	X
Ozone	–	–	–	–	–	–	–	–	–	–
Palmitic acid	A	A	–	F	A	A	F	F	C	A
Petroleum oils, crude, <500 deg. F.	A	A	X	C	X	X	X	C	X	A
>500 deg. F.	C	A	X	C	X	X	X	C	X	X
>1,000 deg. F.	X	C	X	X	X	X	X	C	X	X
Phosphoric acid, crude	A	X	C	C	C	C	C	C	–	A
pure, <45%	A	X	C	C	C	C	C	C	–	A
>45%, cold	A	X	C	C	C	C	C	C	–	A
hot	–	X	C	C	C	C	C	C	–	A
Picric acid, molten	A	C	–	C	C	A	A	C	C	A
water solution	A	X	C	A	A	A	A	A	A	A
Potassium chloride	–	A	A	A	A	A	A	A	–	A
Potassium cyanide	–	A	–	A	A	A	A	A	–	A
Potassium hydroxide	–	A	C	A	A	A	A	A	–	A
Potassium sulphate	–	A	A	A	A	A	A	A	–	A
Producer gas	A	A	–	–	–	–	–	–	–	A
Propane	A	A	–	–	F	A	–	–	–	A
Sewage	A	A	–	C	F	A	X	C	C	A
Soap solutions	C	A	A	C	F	A	–	C	C	A
Soda ash, sodium carbonate	A	A	A	A	A	A	A	A	A	A
Sodium bicarbonate, baking soda	A	A	A	A	A	A	A	A	A	A
Sodium bisulphate	A	C	A	A	A	A	A	A	A	A
Sodium chloride	A	A	A	A	A	A	A	A	A	A
Sodium cyanide	–	A	–	A	A	A	A	A	–	A
Sodium hydroxide	A	A	A	C	C	C	A	C	C	A
Sodium hypochlorite	A	C	A	C	C	C	A	C	C	A
Sodium metaphosphate	A	C	A	C	C	C	A	C	A	A
Sodium nitrate	C	C	A	C	C	C	A	C	–	A
Sodium perborate	C	A	–	C	C	C	A	C	–	A
Sodium peroxide	C	A	–	C	C	C	A	C	–	A
Sodium phosphate, monobasic	A	C	A	A	C	C	A	A	A	A
dibasic	A	A	A	A	C	A	A	A	A	A
tribasic	A	A	A	A	C	A	A	A	A	A
Sodium silicate	A	A	A	A	A	A	A	A	–	A
Sodium sulphate	A	A	A	A	A	A	A	A	–	A
Sodium sulphide	A	A	–	A	A	A	A	A	–	A
Sodium thiosulphate, "hypo"	A	A	A	A	–	A	A	A	A	A
Soybean oil	A	A	–	C	A	A	A	A	C	A
Stannic chloride	A	X	A	A	A	A	F	C	C	A
Steam, <500 deg. F.	A	A	–	A	C	A	–	C	X	A
500–1,000 deg. F.	C	A	–	X	X	X	–	X	X	X
>1,000 deg. F.	X	C	–	X	X	X	–	X	X	X
Stearic acid	A	A	X	C	A	A	C	C	C	A
Sulphur	A	A	–	F	A	F	F	F	C	A
Sulphur chloride	C	X	–	X	F	F	X	X	X	A
Sulphur dioxide, dry	A	A	–	X	C	C	C	C	–	A
Sulphur trioxide, dry	–	A	–	C	C	C	A	A	–	A
Sulphuric acid, <10%, cold	A	F	A	A	A	A	A	A	–	A
hot	A	F	X	A	A	A	A	A	–	A
10-75%, cold	F	X	X	C	C	C	A	C	–	A
hot	F	X	X	C	C	C	A	C	X	A
75-95%, cold	C	X	X	C	C	C	A	C	X	A
hot	C	X	X	X	X	X	C	X	X	A
fuming	X	X	X	X	X	X	C	X	–	A
Sulphurous acid	A	X	A	C	C	C	C	A	–	A
Tannic acid	–	A	A	C	C	C	X	C	–	A
Tar	A	A	–	C	C	C	C	A	X	A
Tartaric acid	–	A	A	C	C	C	A	A	–	A
Toluene	A	A	X	X	F	A	X	X	X	A
Trichloroethylene	C	A	X	X	C	A	X	X	X	A
Turpentine	A	A	X	C	A	A	X	C	X	A
Vinegar	A	A	A	C	C	C	A	C	X	A
Water, acid mine, cont'g oxidizing salts or no oxidizing salts	A	A	A	A	C	A	A	A	C	A
Water, fresh (tap, b'l'r f'd, etc.)	A	A	A	A	C	A	A	A	A	A
distilled, lab. grade	A	A	X	A	C	A	A	A	A	A
return condensate	A	A	C	A	C	A	A	A	A	A
Water, seawater	A	A	A	A	C	A	A	A	A	A
Whiskey and wines	A	A	X	A	C	A	A	A	A	A
Zinc chloride	C	X	A	C	C	A	A	C	A	A
Zinc sulphate	A	X	A	A	A	A	A	A	A	A

Chemical Resistance of Gasket Materials

This chart enables you to select accurately the right "U.S." Gasket for corrosion service

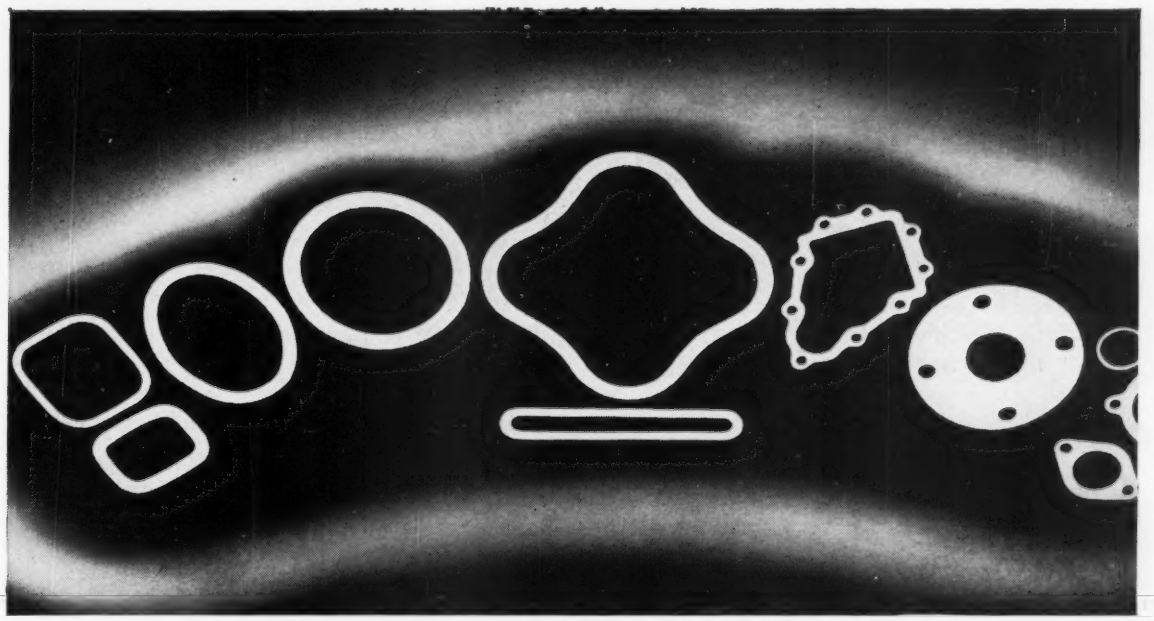
SEND FOR YOUR FREE REPRINT

The chart will be useful in indicating the degree of safety with which the various materials may be used in the service shown.

Those materials known to be suitably resistant have been rated as "A." Those whose resistance is only fair, but not so low as to be dangerous, have been given an "F" rating. An "X" denotes that the material is totally unsuitable. The "C" rating means that the use of this material is dependent upon specific service conditions and should not be selected unless carefully investigated. The blank spaces for the most part represent absence of data.

The generally accepted temperature limit for a good grade compressed asbestos sheet, also called asbestos composition sheet, is 750 deg. F. However, some grades are successfully used at considerably higher temperatures. This type of sheet is used for smooth flanges. For rough flanges, gaskets cut from woven asbestos-metallic sheet or gaskets formed by folding asbestos-metallic cloth are preferred. The latter material is preferable for flanges when bolt pressures are necessarily limited due to the type of flange material.

The all-rubber materials are recommended for temperatures up to 300° F. Higher temperatures are sometimes used but with a lesser degree of safety. Pressures are determined by the type of flange surface.



Examples of U. S. Rainbow Gaskets, Style No. 4009

Outstanding members of the "U. S." line of gaskets. Recommended for packing flanges or other parallel surfaces against hot or cold water, air, saturated steam pressures up to 150 pounds, and all hydraulic conditions.

These gaskets are cut from U. S. Rainbow® Sheet Packing, Style No. 9. They have all the resiliency, pliability and adaptability of the famous Rainbow original Red Sheet Packing. Furnished in any shape, size or thickness.

U. S. Packings and Gaskets are obtainable through any of our 27 District Sales Offices or selected "U. S." distributors.

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ELECTRIC MOTORS
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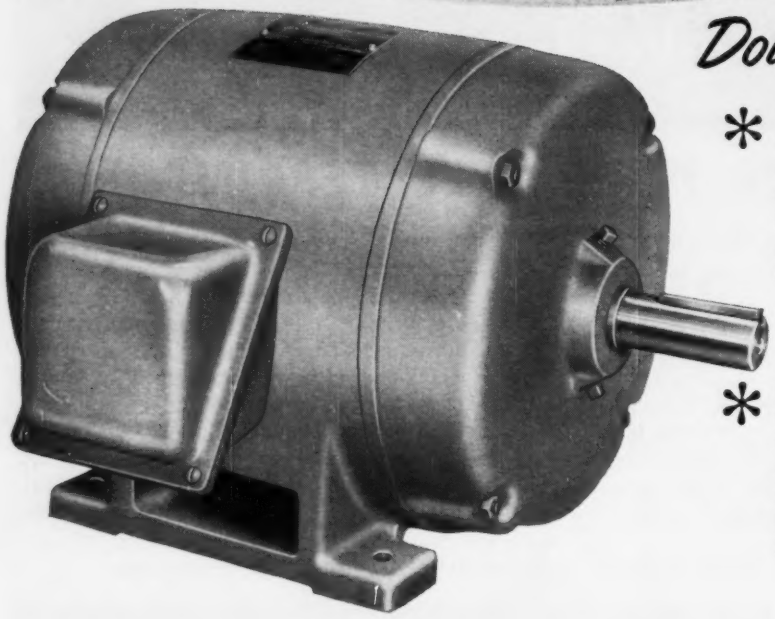
NEW!
Wagner Type DP* Motors
Doubly Protected



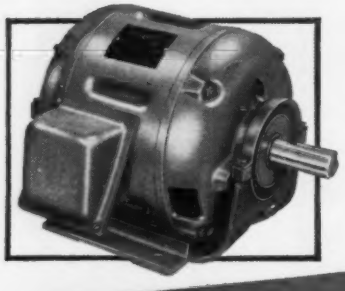
* Wagner Type DP Motors are protected by rugged, corrosion-resistant cast iron frames, smoothly rounded so that no moisture can collect on them. Motor feet are cast as an integral part of the frame for maximum strength and rigidity.

* Enclosures are drip-proof plus! Air intakes are located at the bottom of the endplates — air outlets are located at the base of the frame, one on each side. Specially designed baffles provide protection for the stator windings.

The Wagner line of polyphase, drip-proof general purpose motors—rerated to the new NEMA Standards—pack more power into smaller frames, but give you the same high Wagner Quality and long life performance that have made Wagner Motors "the choice of leaders in industry" for many, many years. These new Wagner Motors are fully protected in the ball bearing models. Their construction makes them completely drip-proof — and virtually splash-proof. The extra large, diagonally split conduit box makes wiring easy. Smaller size and lighter weight means more economical handling and installation.

These new rerated Wagner Motors retain the features desired by plant engineers and maintenance men. They will operate for years without regreasing. But . . . when lubrication *is* necessary or desirable, you *can* lubricate these motors because they are provided with two lubrication openings.

Bulletin MU-202 gives full information—write for your copy today.



AVAILABLE WITH RESILIENT MOUNTING —SLEEVE BEARINGS UP THROUGH 5 HP.

These Wagner standard motors, in ratings up through 5 horsepower, can be used for specialized applications because they are available in sleeve bearing models with endplates that will take resilient mounts.

You can look to Wagner for a complete line of standard motors for specialized applications. The wide range of types and sizes permit the selection of a standard motor for almost any need.

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This comprehensive service is largely responsible for "Virginia's" position as the top SO_2 producer in the nation. Our unexcelled production and shipping facilities—assuring you of prompt and dependable deliveries—have also been contributing factors.

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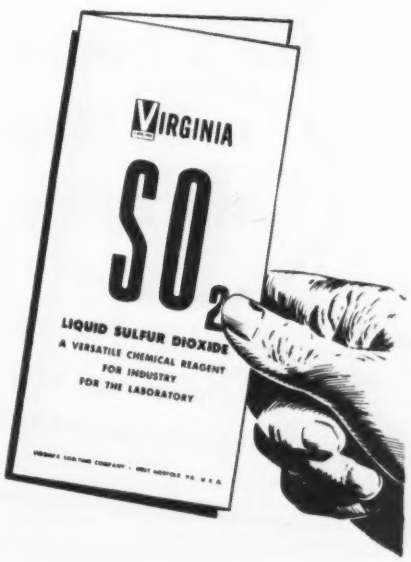

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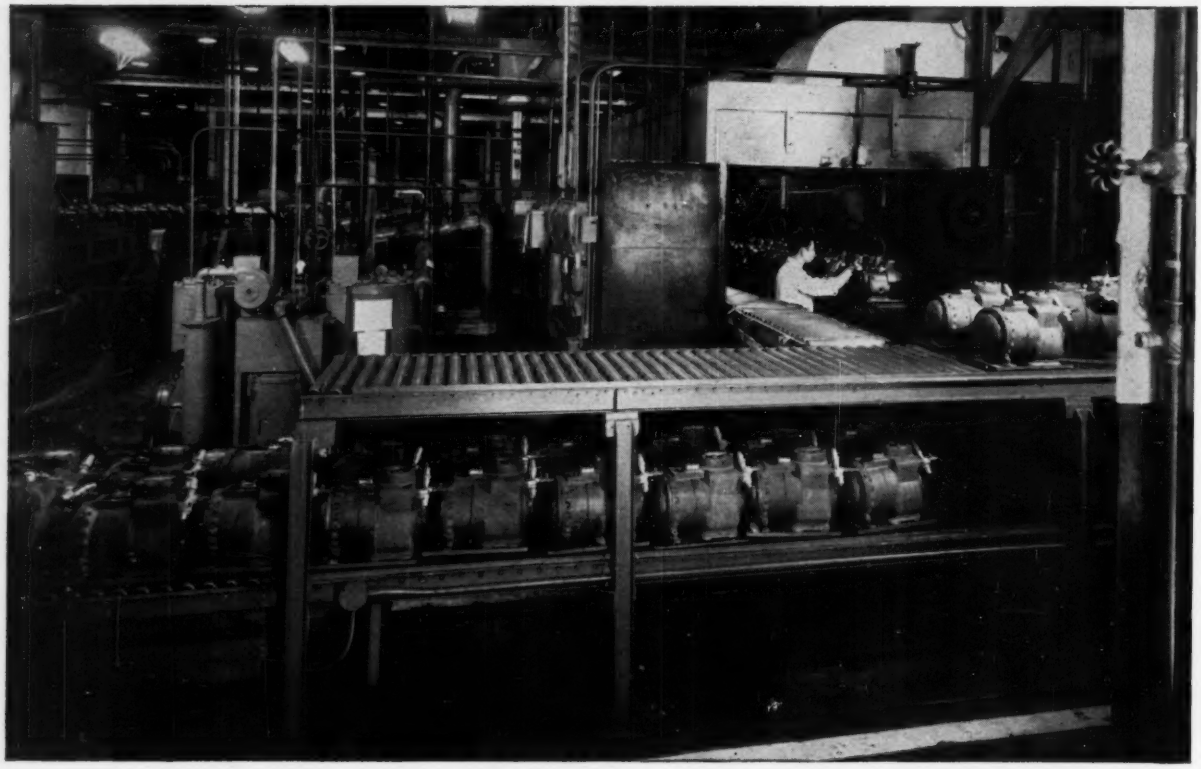


The Lectrodryer at the left dries compressed air as it is fed to compressors in this oven.

Carrier compressors are flushed with DRY air for 8 hours before charging

"NEVER A DEWPOINT above –98° F. since this Lectrodryer* was installed", reports the factory engineer for this Carrier Corporation plant at Syracuse. "Repeated evacuation tests show that we're getting far better purging of moisture with this pressure method than with our former system of vacuum dehydration."

Carrier makes certain there'll be no moisture in refrigeration compressors to give trouble in service by this procedure. In the drying-out oven, compressors are heated to 280° F. and flushed with DRY air for eight hours. Only then are they considered ready for charging.

Lectrodryers are helping similarly on quality control in hundreds of industrial plants. They are DRYing air as it comes from the compressors for plant-wide use, or on location as here at Carrier for special purposes. Entire working areas are being dehumidified to prevent damage to products being processed or in storage.

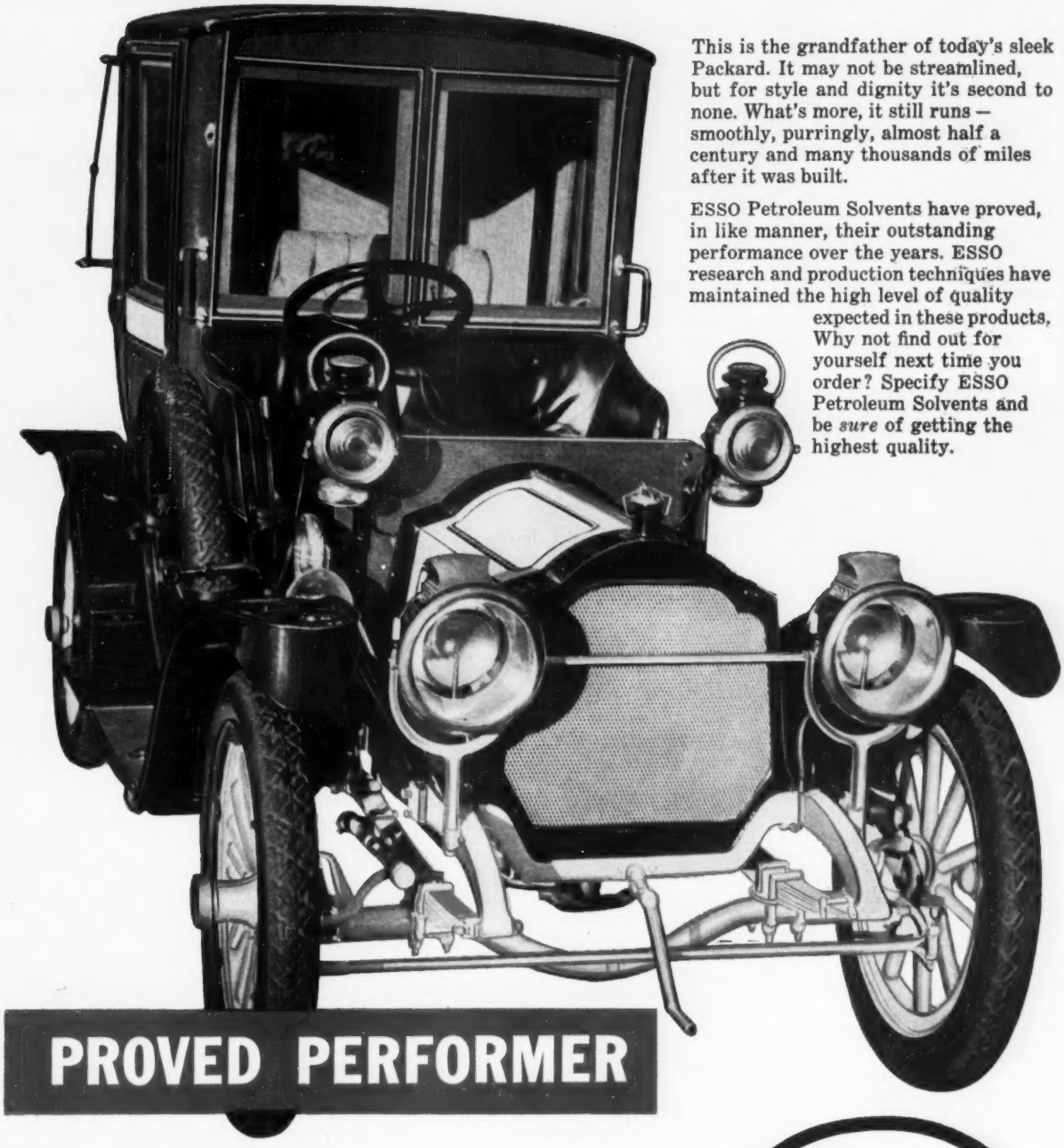
The book, *Because Moisture Isn't Pink,* illustrates many of these industrial applications. For a free copy, write Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pa.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.



This is the grandfather of today's sleek Packard. It may not be streamlined, but for style and dignity it's second to none. What's more, it still runs — smoothly, purringly, almost half a century and many thousands of miles after it was built.

ESSO Petroleum Solvents have proved, in like manner, their outstanding performance over the years. ESSO research and production techniques have maintained the high level of quality expected in these products. Why not find out for yourself next time you order? Specify ESSO Petroleum Solvents and be *sure* of getting the highest quality.

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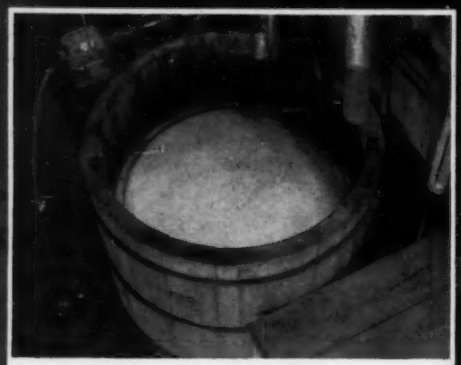
"These



Closeup of Stainless Steel wire filter screen. It has been in continuous service for 2½ years.

IN THIS Niagara Stainless Steel filter, mother liquor is separated from the solids of furoxone.

Stainless Steel filters just don't wear out"

says Norwich Pharmacal Company, Norwich, New York

The Norwich Pharmacal Company is one of the great pharmaceutical houses of this country. Lately, they have attained new distinction as the nation's only source of furacin. Processed furacin is used as a salve for skin graft surgery, and is also helpful for infections of the eye, ear, nose and throat. Raw furacin is used in animal food supplements.

In the production of semicarbazone, an intermediary, diacetate is pumped through a filter that formerly used canvas screens. The screens lasted only a week or two; and in that time they had to be removed and washed 10 to 15 times. It took about 20 minutes to change or clean a screen.

Stainless Steel filter screens were installed 2½ years ago, and, according to Norwich supervisors, "They look as though they will last indefinitely. The Stainless Steel screens have eliminated fear of contamination, too."

Stainless Steel is used in dozens of places in the whole complex process; in nitric acid pumps, nitrators, drums, centrifuges and in the big rotary dryer. According to the supervisory personnel, Stainless Steel keeps the product 100% pure, is very easy to clean, outlasts any other practical metal at least two to one, and the maintenance costs are very low.

These are some of the reasons why so many chemical processors specify USS Stainless Steel for new equipment.

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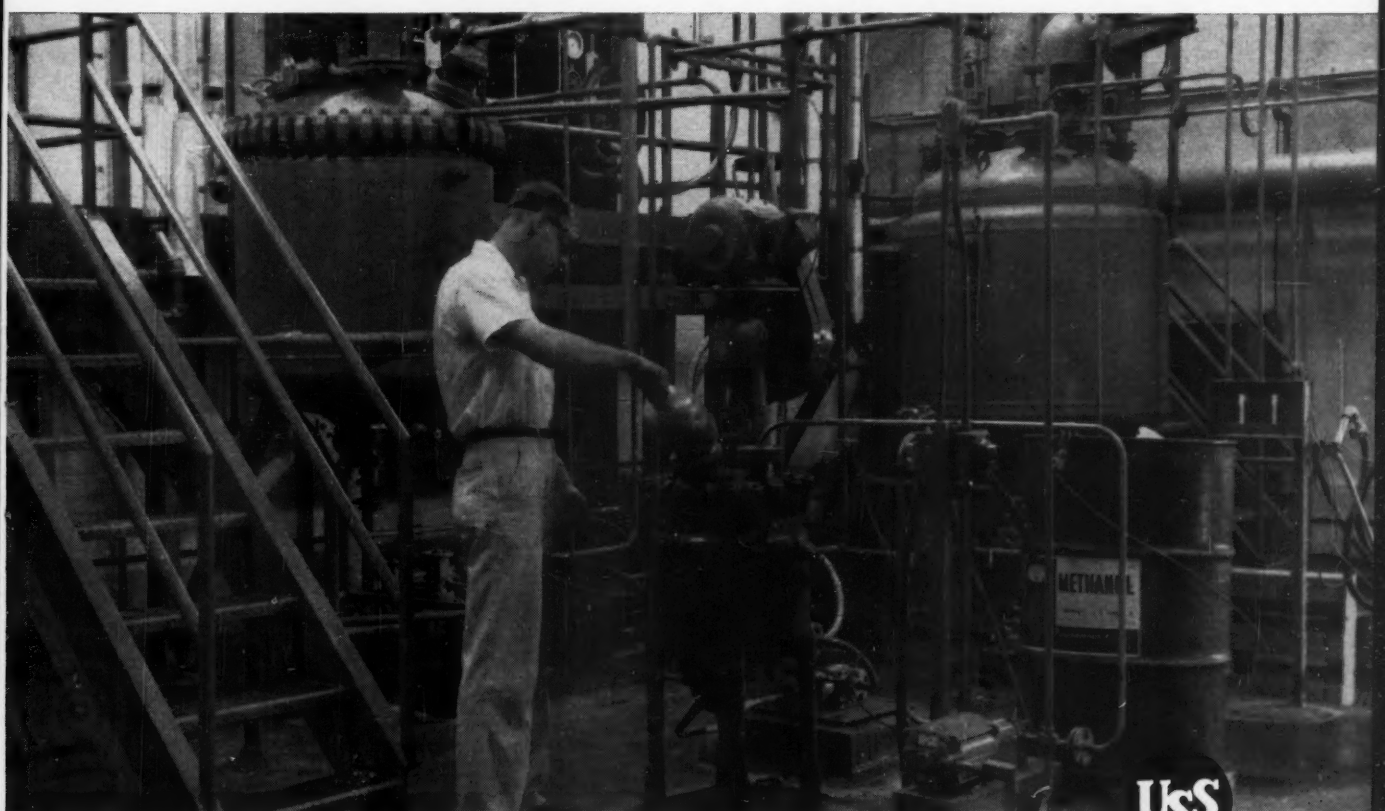
USS STAINLESS STEEL

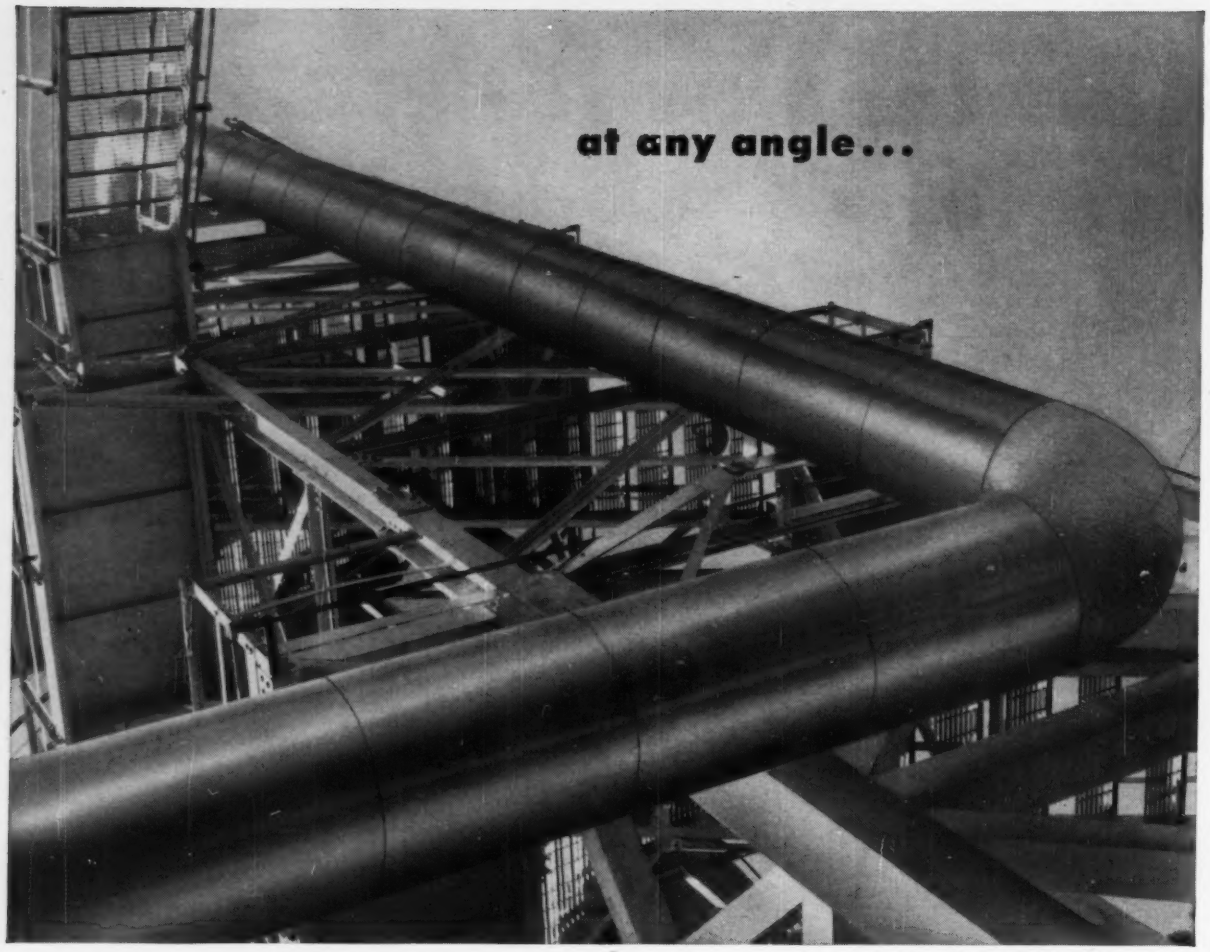
SHEETS • STRIP • PLATES • BARS • BILLETS • PIPE • TUBES • WIRE • SPECIAL SECTIONS

The three tanks shown here are Stainless Steel. Piping and pumps are also mostly Stainless.



USS

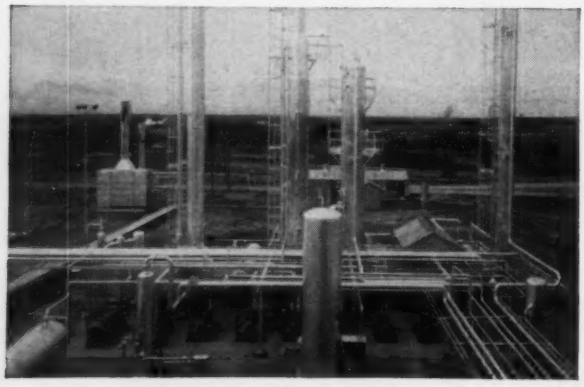
UNITED STATES STEEL



it's easier to insulate pipe with Unibestos®

NO MATTER HOW COMPLEX THE PIPELINE, Unibestos insulation makes installation simpler. It's easily cut, mitered, or grooved for effective insulation of bends, expansion joints, ells, tees and other fittings.

Unibestos' unique construction provides greater protection against heat loss—even at the difficult joints—than other nonfibrous insulation. Amosite, the African long-fiber asbestos, gives Unibestos the extra strength to resist shock and vibration. And Unibestos has excellent chemical stability...withstands moisture, steam, acid or chemical fumes.



STANDARD PRODUCTION SIZES

Unibestos Pipe Insulation is regularly made in 3-foot lengths for pipe sizes from ½″ through 24″, in standard thicknesses through 5″. Unibestos Block Insulation is made in 6″, 12″, 18″ or 36″ widths and in thicknesses from 1″ through 3″ in ½″ increments.

For complete information, write for descriptive Bulletin 109C

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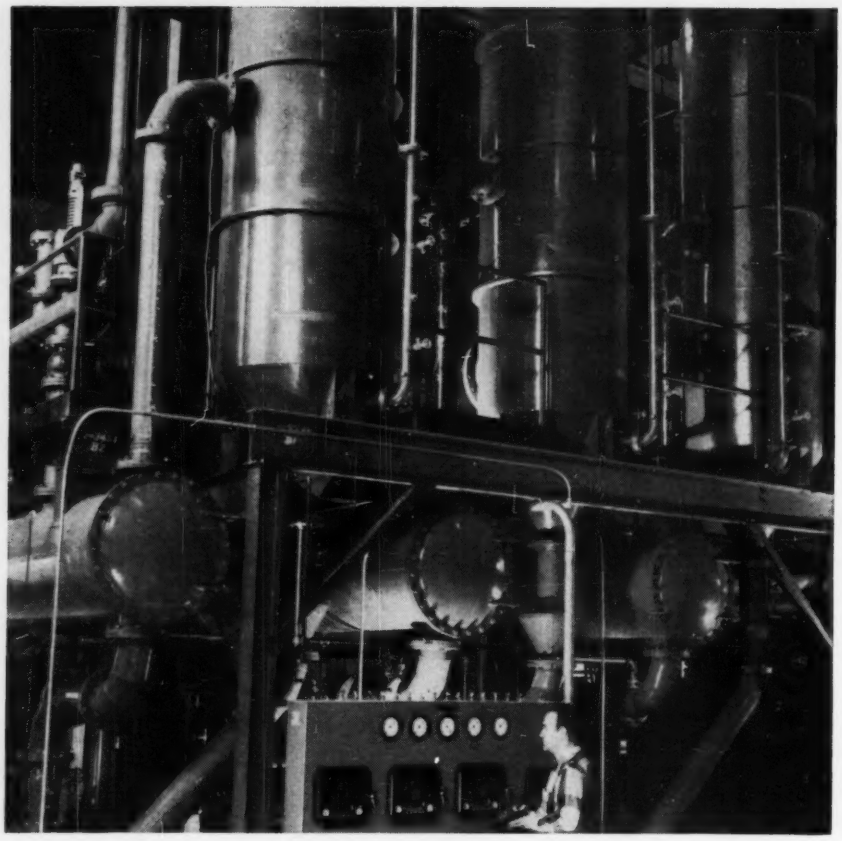

● This Buflovak Triple Effect Forced Circulation Evaporator concentrates lignosulfonates for the Marathon Corporation. It is made of stainless steel, and is simple in design, showing virtually complete recovery of solids. Automatic controls simplify operation.

USING BUFLOVAK EVAPORATORS

Marathon Corporation converts industrial waste into salable, profitable material

To turn a pollution problem into a profitable business, the Marathon Corporation, Rothschild, Wisconsin, decided to convert objectionable waste material to something useful.

The result is the widely used "Marasperse" dispersants, and "Maracelle," a water conditioning chemical.

These useful products are obtained by recovering lignosulfonates from sulfite spent liquor in a patented process developed by Marathon.

Evaporation plays an important role in the process, and this is performed efficiently, economically, by a Triple Effect Forced Circulation Evaporator designed and built by Blaw-Knox Engineers especially for this job.

* * *

Why not let Blaw-Knox Engineers study your by-product or industrial waste recovery problem, perhaps including small scale tests and experimentation on pilot plant scale in our Research and Testing Laboratory, with a report to you on commercial possibilities, production costs, and characteristics of final products.

A complete process equipment service

By-product recovery is but one phase of Blaw-Knox Process Equipment design, engineering and fabrication service for the chemical, food, pharmaceutical, plastic and resin, petroleum, rubber and other industries:

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with Glascote glass-lined pipe and fittings

Ultimate in corrosion resistance... zero contamination with leak-proof joints... lower costs thru longer service life

Glascote glass-lined pipe and fittings are the solution for moving acids or alkali and other corrosive materials. Made with the same precision and quality control used on other Glascote products. Glass linings are applied in successive applications and thoroughly inspected and tested for trouble-free operation. Glascote pipe is highly effective in use with any materials normally processed in glass-lined containers.

Leak-proof gaskets are available to suit materials conveyed in the pipe. What's more installation can be made without special tools. Maintenance can be performed by your own personnel.

Glascote produces and maintains a stock of glass-lined pipe in 10-foot lengths and fittings ranging in inside diameters from 1½ to 4 inches. (6-, 8-inch and larger sizes are fabricated to order.)

Efficient, corrosion-resistant Heat Exchangers may be assembled from lengths of jacketed pipe. The use of either elbows or return bends provides a versatile operating assembly.

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CLEVELAND 17, OHIO

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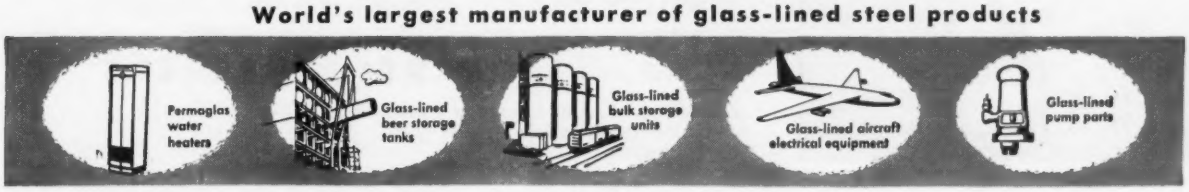
Ask the representative who calls on you for all the facts about Glascote products — reactors, receivers, condensers, evaporators, storage tanks and accessory products. Or, if you prefer, write direct. Glascote Products, Inc., Cleveland 17, a subsidiary of A. O. Smith Corporation.

A subsidiary of A.O.Smith Corporation

World's largest manufacturer of glass-lined steel products



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Breaks them uniformly finer . . . mixes them evenly . . . to provide a host of important advantages.

For example, a Gaulin provides a *smoother* texture, a *freer* flow. *Accents* the taste, scent and color of a product. *Speeds* chemical reactions, or *dispersion* of ingredients — and *reduces* the amount of costly essential ingredients required. *Stops* separation and *improves* lubricity. Just to mention a few.

How about your product?

We'll be glad to show you just how a Gaulin can *improve* your product, *cut* your processing costs — and work with you toward solving any specific problems you may have. Write today for more information.

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Emulsions and dispersions. Gaulins make them stable, uniformly finer. Permit accurate reproduceability.

LIQUID STARCH
Improves transparency, clarity, and stops separation, at lower cost than other methods.

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Gives smoother texture, longer shelf-life. Locks in perfume against evaporation.

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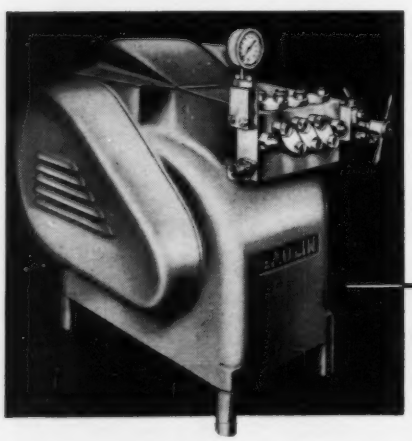
Makes accurate reproduceability possible. Provides uniform, stable emulsions and convenient viscosity control. Increases gloss.



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Ideal for experimental purposes, operation or process requiring up to 25 gallons per hour capacity. Handles quantities as small as one pint. Available on low rental basis.

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Stator is jacketed for cooling or heating. Gap setting adjustable for .001" to .045". Only 45 seconds clean-up required in changing colors. 12" head room. 12" x 17" floor area.

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buy quality

...in a filter

buy Sparkler

...and collect cash dividends in labor savings and operating economies

This Sparkler MCR rectractable tank filter is saving $24,000.00 a year in labor alone for a large mid-west brewery. Every installation of this filter has resulted in lower cost filtering.

The retractable tank idea eliminates the time wasted in breaking pipe connections or outlet seal in opening filter. Fast manipulation with resulting labor saving is a distinctive feature of the MCR filter.

The smooth hydraulic power mechanism simplifies controls to practically a push button operation.

The exclusive Sparkler MCR plate design produces exceptionally high flow rates with unmatched durability.

When you buy a Sparkler MCR retractable tank filter, and see it operate, you have that comfortable assurance you have the best, and most economical, in a heavy duty filter.

10 sq. ft. MCR Models available for sample testing.

Mail coupon for details today
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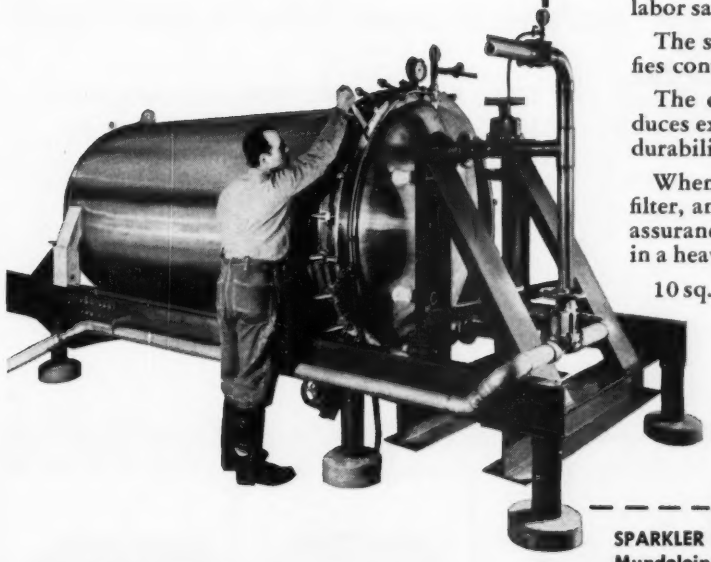

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Mundelein, Illinois **Phone: Mundelein 6-6430**

Manufacturing plants in Canada, Holland, Italy, Australia.
Service representatives in principal cities throughout the world.

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Mundelein, Illinois

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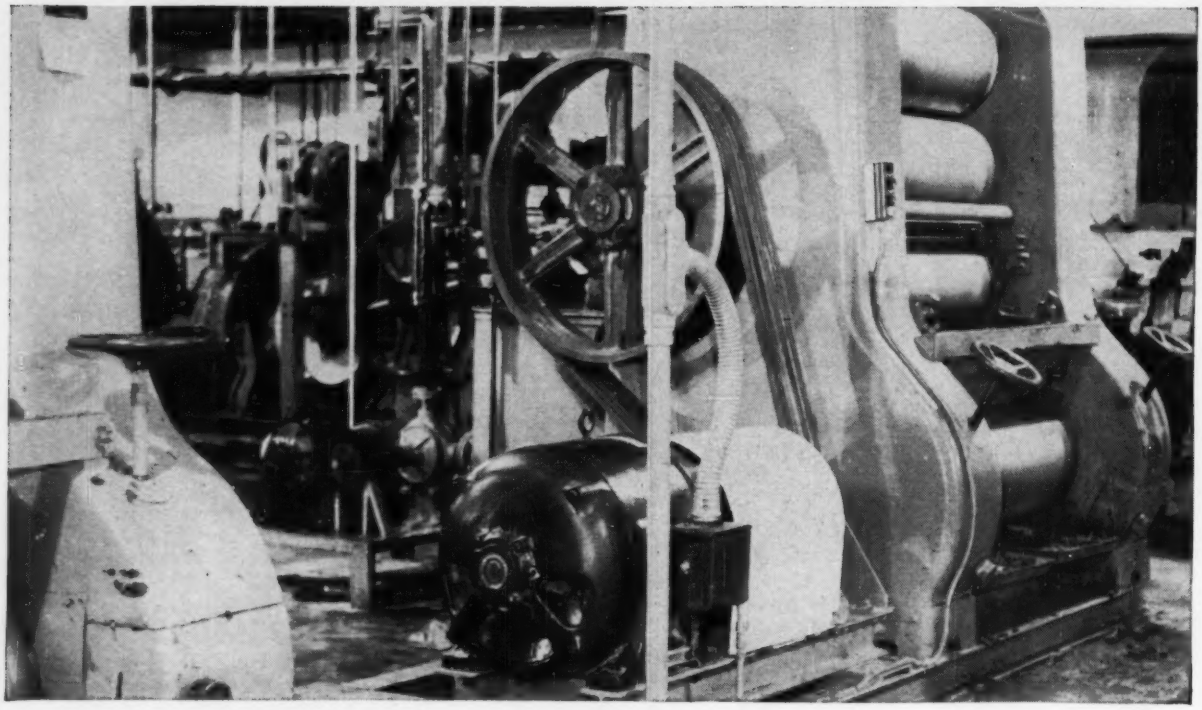
Company_____

Address_____

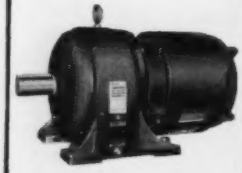


Let each job select

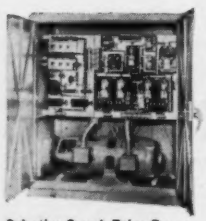
Century MOTORS ARE Performance-Rated®

Why settle for *less* motor than you need? Or why pay for *more* motor than you can use? The most efficient and economical motor is one that is fitted to its application . . . A Performance-Rated Century Motor.

Performance-Rating means simply that from

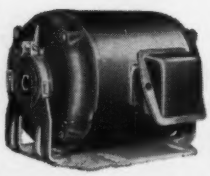


Gearmotors . . . ⅛ to 150 H.P. . . . parallel and right angle shaft . . . "built-in speed to fit your need."

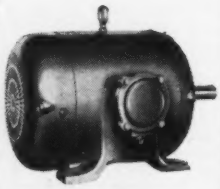


Selective Speed Drive Power Unit . . . 1 to 150 H.P. . . . a wide range of flexible speed for automatic operation and where fine increments of speed are required.

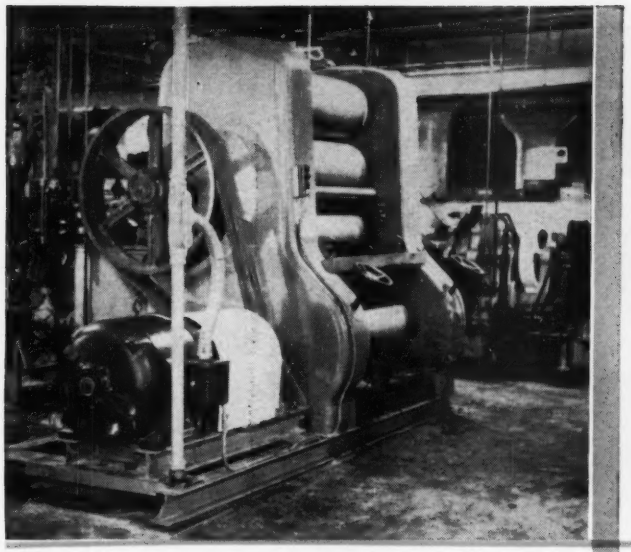
Direct Current Motors . . . ⅛ to 300 H.P. . . . a dependable teammate for Selective Speed Drives and where DC is available and its use desirable.



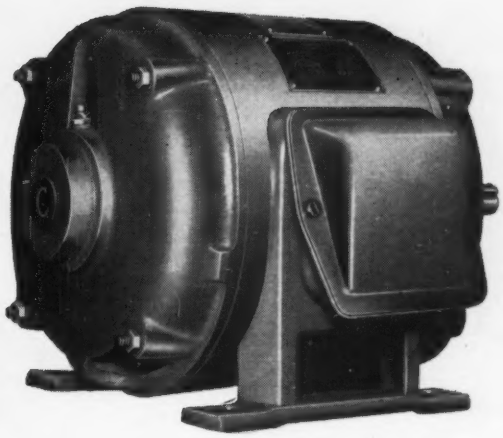
Squirrel Cage, Polyphase Motors . . . ½ to 400 H.P. . . . available in drip proof and dust proof frames, with sleeve or ball bearings, foot or flange mounting (cushion base available through 5 H.P.).



Explosion Proof Motors . . . 2 to 50 H.P. . . . Underwriters Laboratory listed for safe operation in hazardous atmospheres.



for example: Five-roll refiners are powered by rugged 60 H.P. Century Performance-Rated Motors, chosen to stand up under punishing loads.



Century Motors for Modern Ideas . . . AC or DC . . . Single-phase or Polyphase . . . drip proof, dust proof or explosion proof frames.

its own motor!

TO FIT YOUR SPECIFIC NEEDS

Century's complete line of motors and generators you'll get precisely the right size, speed, frame enclosure and torque characteristics you need. Century application engineers or Authorized Century Distributors are always available to help you fit a Performance-Rated Motor to your job.

FOR THE FULL FACTS ON CENTURY PERFORMANCE-RATING, MAIL THIS COUPON TODAY

To CENTURY ELECTRIC COMPANY
1806 Pine Street, St. Louis 3, Mo.

Please send me information about

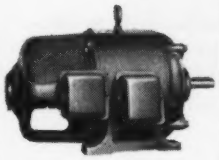
.....

Name.....*Title*.....

Company.....

Address.....

City.....*Zone*.....*State*.....



Slip Ring Motors . . . 1 to 400 H.P. . . . a favorite for applications requiring unusually low starting current. Available in drip proof, splash proof and dust proof frames.

Performance-Rated® Motors

1/8 to 400 H. P.

Offices and Stock Points in Principal Cities

CENTURY ELECTRIC COMPANY

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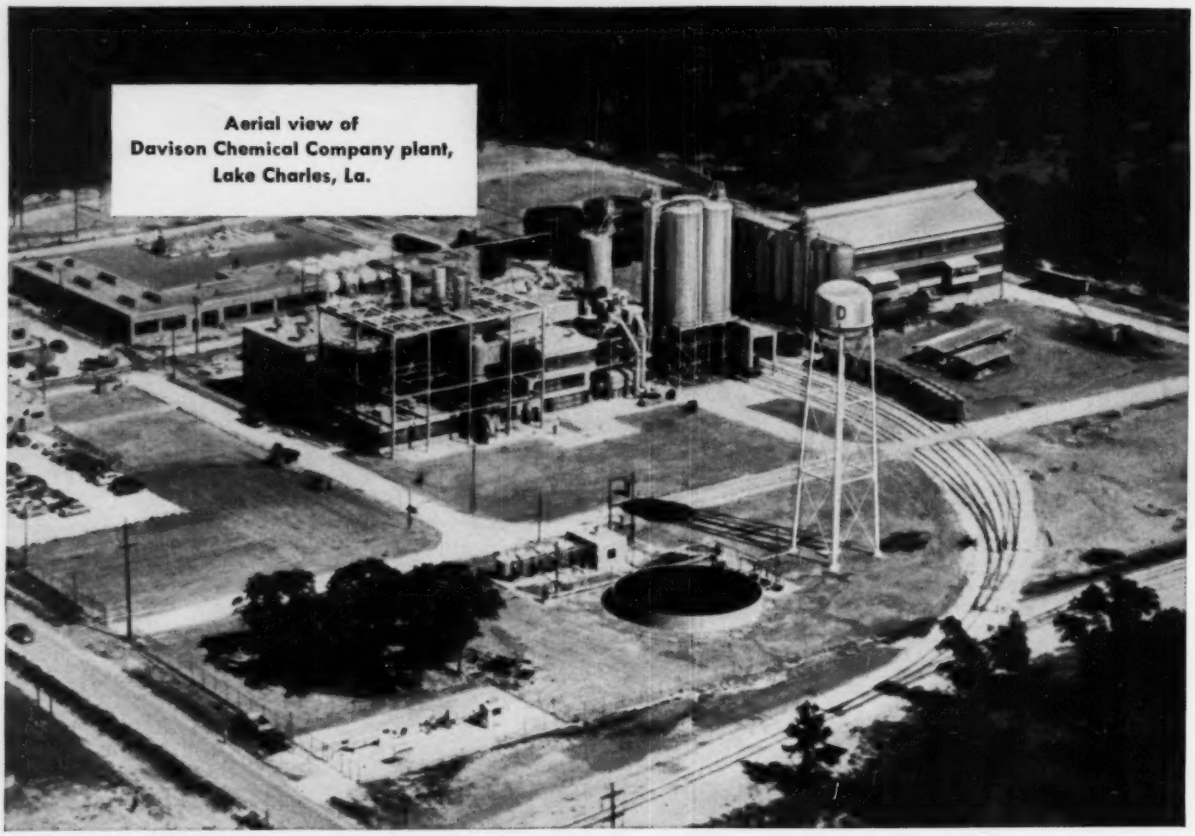


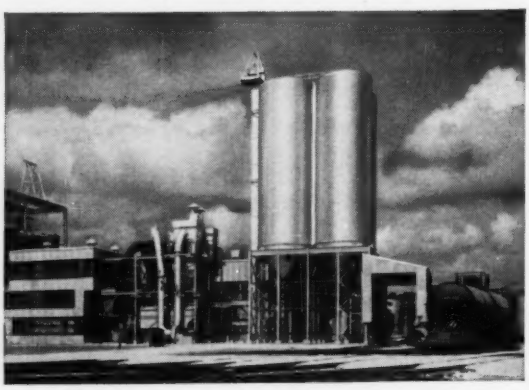
Aerial view of
Davison Chemical Company plant,
Lake Charles, La.

Reynolds Alumina Trihydrate Meets Rigid Requirements for Production of High Grade Petroleum Cracking Catalysts

Davison Chemical Company sets high standards of purity and reactivity for Silica-Alumina Product

Only highest quality raw materials can meet the needs of the Davison Chemical Company, division of W. R. Grace & Co., for its synthetic fluid-type petroleum cracking catalyst. Purity and reactivity are major considerations in selecting the components of this vital product, a readily fluidized catalytic material which shows no appreciable disintegration in cracking units.

The alumina trihydrate used by Davison is one of several grades of pure aluminum hydroxide manufactured by Reynolds. Commercial, organic-free and low-iron grades are available in a range of particle sizes. For full information call on your nearby Reynolds office listed under "Aluminum" in the classified telephone directory, or write *Reynolds Metals Company, P. O. Box 1800-CJ, Louisville, Kentucky.* A free brochure on *Reynolds Aluminum Chemicals* is also available.



Catalyst manufacturing building showing secondary filtering and water treating area, flash driers and finished product silos.

REYNOLDS CHEMICALS from the Makers of Reynolds Aluminum

REYNOLDS ALUMINUM

MODERN DESIGN HAS ALUMINUM IN MIND

OLDEST

...yet

KIELEY & MUELLER is the *oldest* control valve manufacturer in the United States.

However, K&M offers the *newest* diaphragm control valve design. The K&M Series 1400 diaphragm control valve was not *adapted* to high lift, it was *completely designed* for it. That's why K&M exceeds today by every measure of control valve performance . . . and valve manufacturing experience. That's why K&M is the valve *that likes to be compared.*

Write for Bulletin CV-5

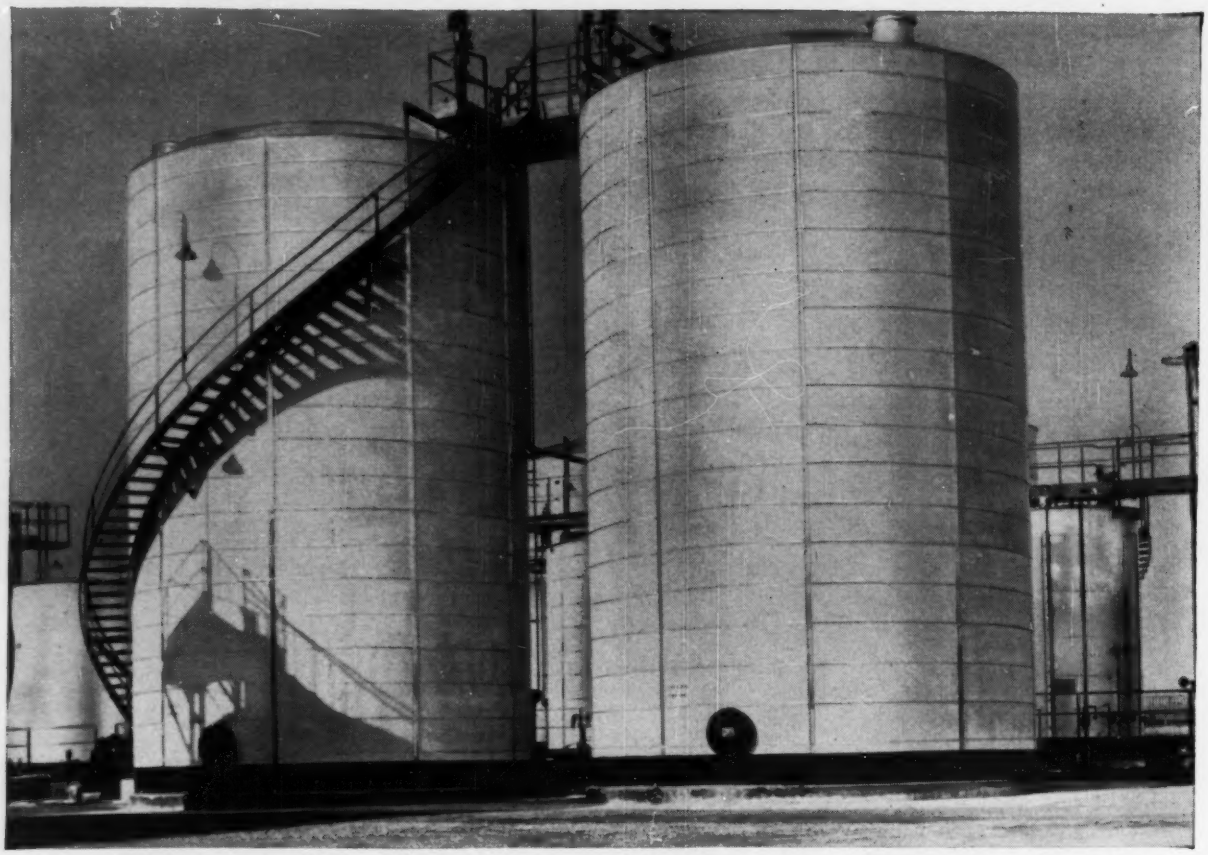
77th Anniversary...Oldest U. S. Pressure and Level Control Valve Manufacturer

K&M

KIELEY & MUELLER, INC.

diaphragm control valves

64 Genung Street
Middletown, New York



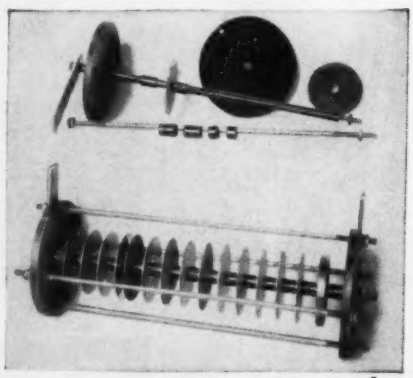
In these nickel-clad tanks, phenol synthesized from cumene is kept pure for long periods. Run-down tanks used to check the product against specifications as it comes off stream are also nickel-clad.

Nickel-cladding guards phenol purity in new synthetic plant

With phenol, metallic pick-up alienates customers.

That's why engineers, in designing one of America's newest synthetic phenol plants for Standard Oil Company of California, made these two big storage tanks . . . and three run-down tanks . . . of nickel-clad steel. The synthetic produced is marketed by Standard's subsidiary, Oronite Chemical Company.

Experience over the years has proved that phenol can be stored in nickel or nickel-clad steel for prolonged periods with negligible metal pick-up. Phenol stays premium-market pure, color excellent . . . a big factor in keeping customers for 35,000,000 pounds of product per year happy.



Good in production, too

In many synthetic plants, nickel and high-nickel alloys, such as Monel®, a nickel-copper alloy, are also used in reactors and other items of production equipment. These alloys possess high resistance to corrosion by acids, caustic soda and many other corrosive chemicals.

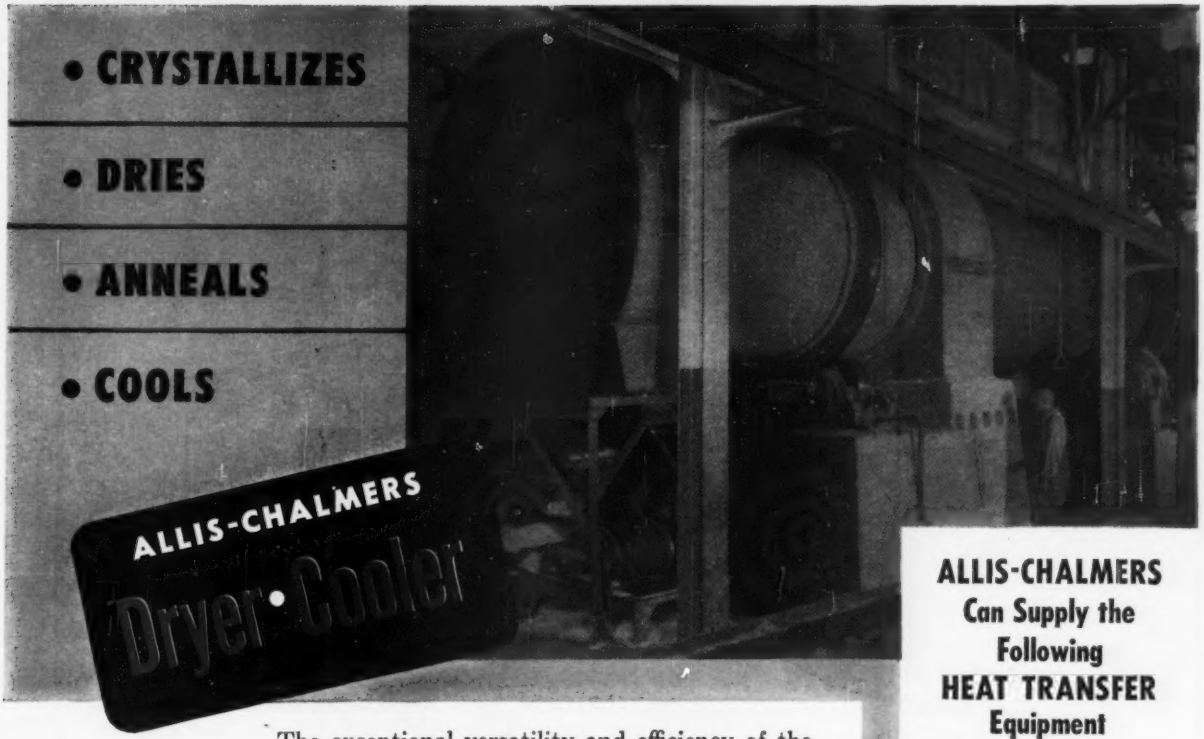
Do you have a corrosion or purity problem connected with the manufacture or handling of phenol? Write to Inco's Corrosion Engineering Section. They will be glad to give you the benefit of their experience and research without cost or obligation.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK **Nickel**... for purity

Does 4 Big Jobs—

- CRYSTALLIZES
- DRIES
- ANNEALS
- COOLS



The exceptional versatility and efficiency of the dryer-cooler *originated* by Allis-Chalmers is demonstrated in a crystallization process. In this operation, salts or precipitates are rapidly crystallized or pelletized from solution — then dried, annealed and cooled in a *continuous* flow.

SAVES Equipment Cost, Space, and Material Handling

This combination equipment is particularly adaptable to drying and cooling of wet, sticky material. Because drying and cooling are done in one unit, a sizable saving is realized on equipment cost . . . handling of material between dryer and cooler is eliminated.

For Low Temperature Heat-Treating

This multi-duty equipment may also be used for low temperature (800 F or less) heat-treating and cooling.

In operation, drying or heating is accomplished with a parallel flow, cooling with a counterflow. If immediate cooling is not essential to your process, the Allis-Chalmers dryer-cooler may be fired from both ends in drying or heat-treating.

WRITE FOR LITERATURE

Bulletin 07B6368 covers most of Allis-Chalmers heat transfer equipment. Individual bulletins covering specific equipment lines are also available. See your Allis-Chalmers representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4792

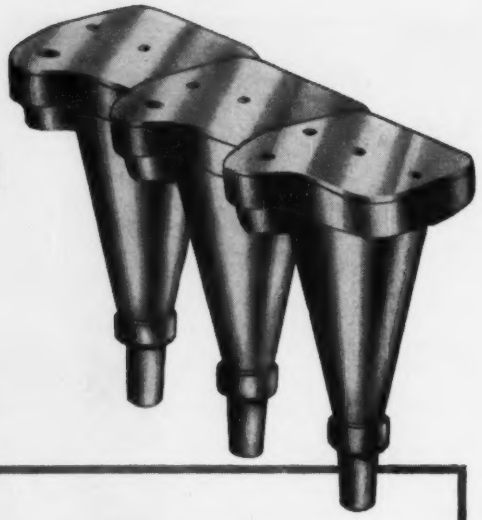
ALLIS-CHALMERS Can Supply the Following HEAT TRANSFER Equipment

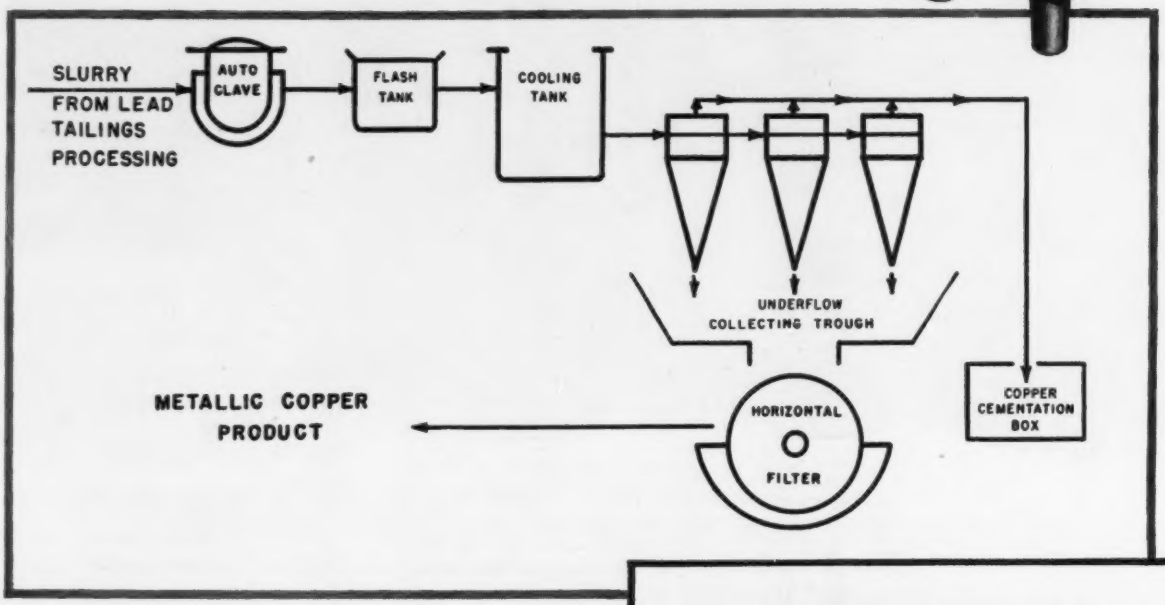
- **Direct Heating**
  - Rotary Kilns
  - Rotary Dryer
  - Bruckner Roaster
  - Traveling Grate Furnace
  - Ribbon Flight Dryer
  - Multiple Hearth Furnace
  - Flat Hearth Furnace
- **Indirect Heating**
  - Rotary Dryer
  - Tube Dryer
  - Ribbon Flight Dryer
  - Double Drum Dryer
  - Rotary Steam Dryer
- **Cooling**
  - Air-Quenching Cooler
  - Rotary Cooler
  - Dryer-Cooler
  - Tube Cooler
  - Rotary Drum Cooler

ALLIS-CHALMERS

These Heyl & Patterson 3" Cyclones

improve the Recovery of Copper from Lead Tailings





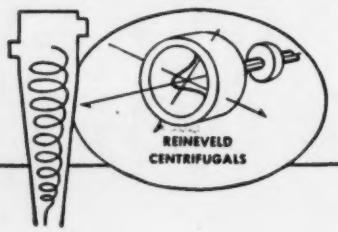
The engineers of a large Lead Company wanted to improve the system they had been using to remove metallic copper from tailings. They wrote to Heyl & Patterson, giving an outline of their problem.

A H&P Engineer visited the plant to see the original recovery system. After watching it in operation, he made a rough sketch of a New System utilizing H&P 3" Cyclones. Engineers in the H&P Special Apparatus Division approved the proposed system and suggested that a test be made under actual operating conditions. The results showed that H&P 3" Cyclones would recover 98-99% of the freshly precipitated Metallic Copper . . . a substantial gain over the original method . . . as well as rejecting an undesirable calcium salt.

HOW THE NEW SYSTEM WORKS:

The Tailings are first processed at a high temperature. After processing, the slurry is reduced to about 170° F., and is fed from a cooling tank to H & P 3" Cyclones. The cyclone underflow contains 98-99% finely divided metallic copper at 15-20% solids by weight. The overflow is carried to a cementation box where the soluble copper is removed. The metallic copper, a spongy, cake-like mass, discharges directly into a horizontal filter. When removed from the filter, the copper metal product has a moisture of 12-15%, and is ready for marketing.

Heyl & Patterson
INC.



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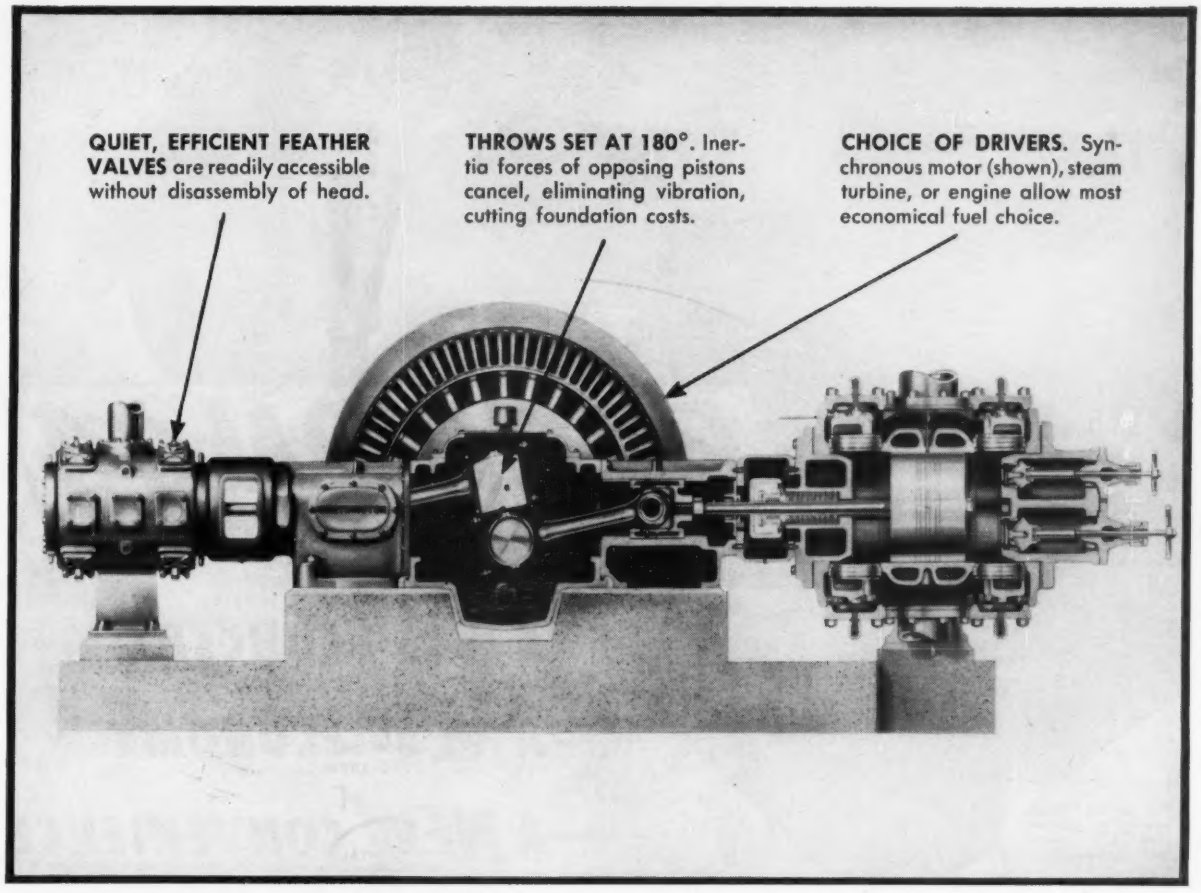
PHONE COurt 1-0750


QUIET, EFFICIENT FEATHER VALVES are readily accessible without disassembly of head.
THROWS SET AT 180°. Inertia forces of opposing pistons cancel, eliminating vibration, cutting foundation costs.
CHOICE OF DRIVERS. Synchronous motor (shown), steam turbine, or engine allow most economical fuel choice.

CUTAWAY VIEW of Worthington's new balanced-opposed compressor shows double-throw crankshaft with cranks set at 180 degrees. Reciprocating weights of pistons always travel in opposite directions, cancelling out all inertia forces. Result: fewer vibration problems; consequently, simpler foundation.

New balanced-opposed compressor handles multi-services all at once

When you have process requirements existing at different low-temperature levels, you don't need a battery of compressors. All you need is one Worthington balanced-opposed unit — with only one driver.

The new balanced-opposed compressor is specifically designed to handle single or cascade refrigeration duties. What's more, you can combine on the same frame refrigeration loads with gas compression, similar to that encountered in chlorine condensing and carbon dioxide liquefaction systems. Result: a big saving in installation and operating costs.

Here are more cost-cutting features:

BALANCED-OPPOSED PRINCIPLE (which virtually eliminates transmission of unbalanced shaking forces to foundation) plus simple frame design permit use of smaller, less expensive foundation.

FEATHER* VALVE OPERATION. Worthington's exclusive Feather Valve provides unusually high compression efficiency — bringing power costs 'way down.

MINIMUM MAINTENANCE COSTS — made possible by quick, easy accessibility to all compressor cylinders and running gear.

WIDE CHOICE OF DRIVERS — synchronous motor, steam turbine, internal combustion engine — whatever drive is easiest, cheapest for you to use.

You can get the Worthington balanced-opposed compressor in sizes from 300 HP all the way up to 10,000 HP. Write for details today to Worthington Corporation, Air Conditioning and Refrigeration Div., Section A.5.60-CG, Harrison, N.J. A.5.60

*Reg. U.S. Pat. Off.

WORTHINGTON

CLIMATE ENGINEERS TO INDUSTRY, BUSINESS AND THE HOME

IN CORROSION-PROOF LININGS

Resilon 44 is a depolymerized rubber and resin base thermoplastic in flexible sheet form which can be installed by your own workmen using only a torch and a trowel. Think for a minute what this means . . . your own crew can handle lining installations and repairs as needed with less equipment down-time and at very low installed cost. (Should you prefer, we will install it for you. And you'll still save money.)

Resilon 44 is simple and easy to apply. No adhesives or vulcanizing is required. Sheets are "heat welded" to properly prepared steel or concrete with a torch. This fuses them so tightly that the bond is as strong as the material itself. V-joints are filled with Resilon 44 strips, then fused and smoothed with a heated trowel. The result is a seamless, impermeable lining membrane, at an installed cost well below equivalent linings.

Resilon 44 is very dense with high dielectric strength. It is resistant to non-oxidizing acids, alkaline and caustic solutions at temperatures up to 150°F. Within temperature limits it remains flexible and non-tacky, and does not decompose or age. Resilon 44 may be used alone except where danger of mechanical damage exists. Then it is oversheathed with one course of acid proof brick laid in Durisite or Vitric 10 cement, which incidentally extends temperature limits upwards by 50° or more.

It will pay you to investigate the time-, money-, inconvenience-saving properties of Resilon 44.

132E

Get all the facts . . .

Write today for your copy of Bulletin RL-510 RESILON 44, which gives all the data on Resilon 44 including a table of chemical resistances.

If you have a difficult lining problem our Process Equipment Division will be glad to consult with you without obligation.

PROCESS EQUIPMENT DIVISION

U. S. STONEWARE

AKRON 9, OHIO

OCTOBER
1955

Chementator

Edward T. Thompson

● **AEC wants some firm to make 400,000 lb./yr. more zirconium for the next five years. Twice current production, this metal, plus all hafnium concurrently produced, will go into new nuclear reactors.**

● **Shakedown-runs with a new exclusive process are on at Allied's new nylon 6 (polycaprolactam) fiber plant at Chesterfield, Va.**

● **Commerce Dept. thinks new oxythermic process for CaC_2 being tested in Germany may end carbide's reliance on electricity.**

Worker unions ogle engineers

Drives to unionize engineers and other technical employees continue unabated; if anything they're gaining momentum. But now pressure comes from two worker unions as well as the professional units.

A midsummer move to enlist the "technical engineering employees of Texas" in the American Federation of Technical Engineers (AFL) brought an avalanche of letters to engineers on the Gulf Coast. Prime targets of the mail campaign, which preceeds personal calls by union organizers, are men in firms with big engineering staffs.

Comparing pay and working conditions of organized manual tradesmen with those of engineers and technicians forms the main theme.

And in Denver, the CIO's 160,000-member Oil, Chemical and Atomic Workers International Union set up a special committee "to study the possibility" of organizing professional employees.

OCAW feels that it is pioneering in an area that has few guideposts, hence, is moving cautiously. Common opinion holds that the technical employee is a lone operator, more concerned with professional recognition than with hours and caring more for stock plans than for pay raises. OCAW leader thinks along these lines, too.

But to double-check, they're discarding past organizing ideas, hoping to tailor an approach that will appeal to the professional. First step is a survey to learn what he lacks now in working conditions. Then OCAW will try to dope out how it can aid him, and thus gain his support.

Timing of OCAW's organizing drive is uncertain. But the union feels that within the next decade the sheer number of technical men will force employers to deal with them as a group—and overlook the needs of the individual in the process. When this happens, experience has shown that the individual looks to collective bargaining.

U. S. processes move to Canada

Development of a raft of new processes devised by Dr. Marvin J. Udy, Niagara Falls consultant, has been taken over by Strategic Materials Co. of Montreal. Most likely to go commercial soonest are a new electrothermic way to upgrade low-grade manganiferous ores and a startling new calcium carbide furnace.

Slated for immediate intensive work is the manganese process. SMC is about to start building a semicommercial unit comprised of four 1,500-kw. furnaces and a calcining unit at St. Catherine, Ont. Output will be 12-15 tons/day of ferromanganese from ore that averages about 12% manganese. And it's hoped that the process will be adaptable to other low-grade ores, such as asbestos tailings to yield ferronickel.

The new carbide furnace, second on SMC's priority list, has tremendous implications. For it

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produces 100% carbide in continuous ingots at little or no power increase over that needed for the 80-85% carbide now made commercially. This means that acetylene yield will be about 5.6 cu. ft./lb. of carbide instead of 4.5 cu. ft. which is normal today.

In present plants, carbide is removed from furnaces by tapping, so operating temperature must be above 3,812 F., the melting point of 85% carbide. (100% carbide melts at 4,172 F., too high for practical furnace operations.) But Udy reasoned that 100% carbide could be made at temperatures as low as 3,270 F. if tapping was eliminated. So he turned to continuous ingot production in two types of furnaces—vertical and horizontal.

The horizontal type looks like the best bet on a large scale. In this furnace, part of which looks like a glorified tunnel dryer, a continuous line of refractory-covered flat cars moves through the furnace on tracks under the carbon electrodes. Lime is charged around the electrodes and carbide deposits on the cars. The electrodes can be staggered, each a little higher from the car level than its predecessors, so the layer of carbide gets thicker and thicker. The carbide emerges from the furnace as a continuous ingot.

Look what's happening in rubber

The nation's synthetic rubber industry, normally quiescent since World War II, has suddenly blossomed forth in a surge of increased output, plant expansions and new products. Main trigger, of course, was the purchase of government-owned plants by private business.

U. S. consumption of all synthetic rubber for the first 7 months of this year was 39.7% over 1954—503,892 long tons vs. 360,731. Some of this jump was a natural outgrowth of the more than 100% boost in natural rubber prices in less than a year. Another part resulted from increased use of cheap oil extenders with GR-S.

Goodyear's Houston GR-S plant, for intsance, was rated at 99,600 tons/yr. by the government. Now, through improved technology and use of oil extenders, it can make 137,500 tons/yr.

But high as it is, production of straight synthetic (not counting oil extenders) is probably only 70% of capacity, largely because the 122,000-ton/yr. Institute, W. Va., plant isn't running. However, if revived government efforts to sell this plant succeed (Chementator, Sept.), the production picture could change mighty fast.

Demand keeps growing fast. And expected increases over the next five years are causing most producers to think about—and act on—expansion. Goodyear will boost its Houston capacity 25% by early 1957 and another 25% soon afterward. Firestone's Lake Charles, La., plant is being expanded to 150,000 tons/yr., 50% more than its "government capacity." Phillips will have completed a 15% expansion at Borger, Tex., by next fall. And Goodrich-Gulf, U. S. Rubber and Copolymer Corp. all expect to add to their plants soon.

High in interest, too, are two new synthetic rubbers developed by Goodrich-Gulf and Firestone that duplicate natural rubber.

Goodrich-Gulf first announced theirs late last year, then recently decided to build a pilot plant in Ohio. Large truck tires made wholly of the new rubber are giving satisfactory fleet service now. Firestone was mum about its work until late August when it revealed that a pilot plant is already running and that more than a half-million miles of tire tests have been completed.

Clean beans needed to cut glut

For the first time in history, soybean growers expect a crop surplus. This year's acreage set a new high, and normal weather will bring a record 400-million-bushel harvest. It will also bring a major disposal problem.

There's no hope that the domestic market can stretch far enough to cover this surplus. And new uses (such as improved paint vehicles) for either the oil or the meal are still in the research labs. So producers are turning to the export market and, as a first step, are moving to repair the damaged reputation their product carries abroad.

As the world's top supplier, U. S. growers have shipped low-quality beans (split or damaged, and contaminated with foreign matter) to overseas buyers with a "take it or leave it" attitude. Pleas for cleaner beans with less foreign matter were long ignored. But this September higher standards went into effect in a move to restore confidence and help U. S. producers sell their surplus without upsetting home markets.

New values from waste sulfite liquors

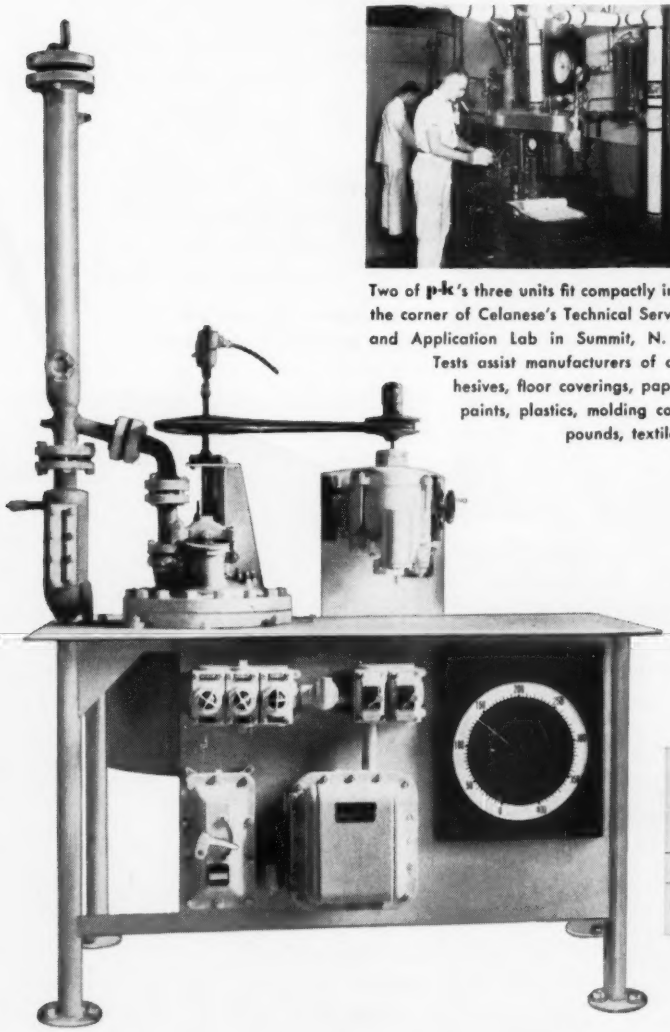
Using its own new anion exchange resin, Rayonier, Inc., has come up with the first economical process for commercial recovery of pure lignosulfonates from waste sulfite pulping liquor.

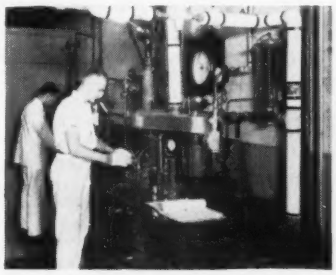
The process (covered by U.S. 2,710,254 and 2,710,255) works about equally well on calcium,

(Continued on page 108)

Packaged Pilot Plants

Flexible . . . compact . . . accurate . . . these 'packaged' units are performing hundreds of experiments to help Celanese assist its customers in developing better products





Two of p-k's three units fit compactly into the corner of Celanese's Technical Service and Application Lab in Summit, N. J. Tests assist manufacturers of adhesives, floor coverings, paper, paints, plastics, molding compounds, textiles.

The apparatus at left below is a packaged **p-k** pilot plant, designed for resin experimentation, in five gallon capacity and standardized design.

Three are at work at Celanese Corporation of America's big Research Center: one for vinyl acetate monomers and co-ploymers; one for urea, melamine, and phenol-formaldehyde resins; and one for pentaerythritol alkyd resins. All work full time for Celanese customers.

Each is flexible enough to handle a multiplicity of small operating tests; accurate enough to permit projection to full scale plant operation; adaptable to the most specialized research needs; and low in price. Specifications for the unit at left are typical:

REACTOR: 5 gallon working capacity • 150 PSIG design pressure • Internal cooling cylinder • Electric heater capacity of 6000 watts • Thermostatic controls • Variable speed agitator with hollow shaft for injection of gases into material • Water cooled stuffing box • Sight glasses and other extra connections.

REFLUX CONDENSER: Arranged to operate in any position. Additional condenser may be hooked up for use as a still.

RECEIVER AND DECANTER: Again, stainless steel for all interior surfaces.

The unit shown is just one of **p-k**'s line of *standardized* pilot plants and autoclaves of 5, 10 and 15 gallon capacity and up. Each provides a wide range of temperatures and pressures for flexible operation. Heating is by steam or electricity. Internal surfaces are stainless steel.

Want a quotation? We'll send complete specifications on a pilot plant for you, plus a catalog on **p-k**'s wide line of research, development and production equipment for the processing industries. Write today.

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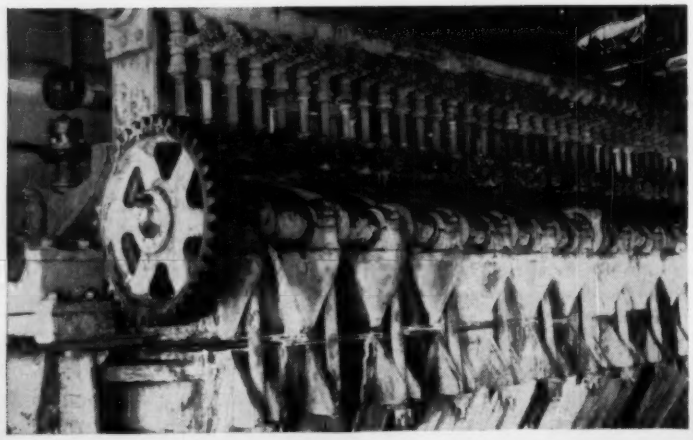
Dorr-Oliver Techniques

AT

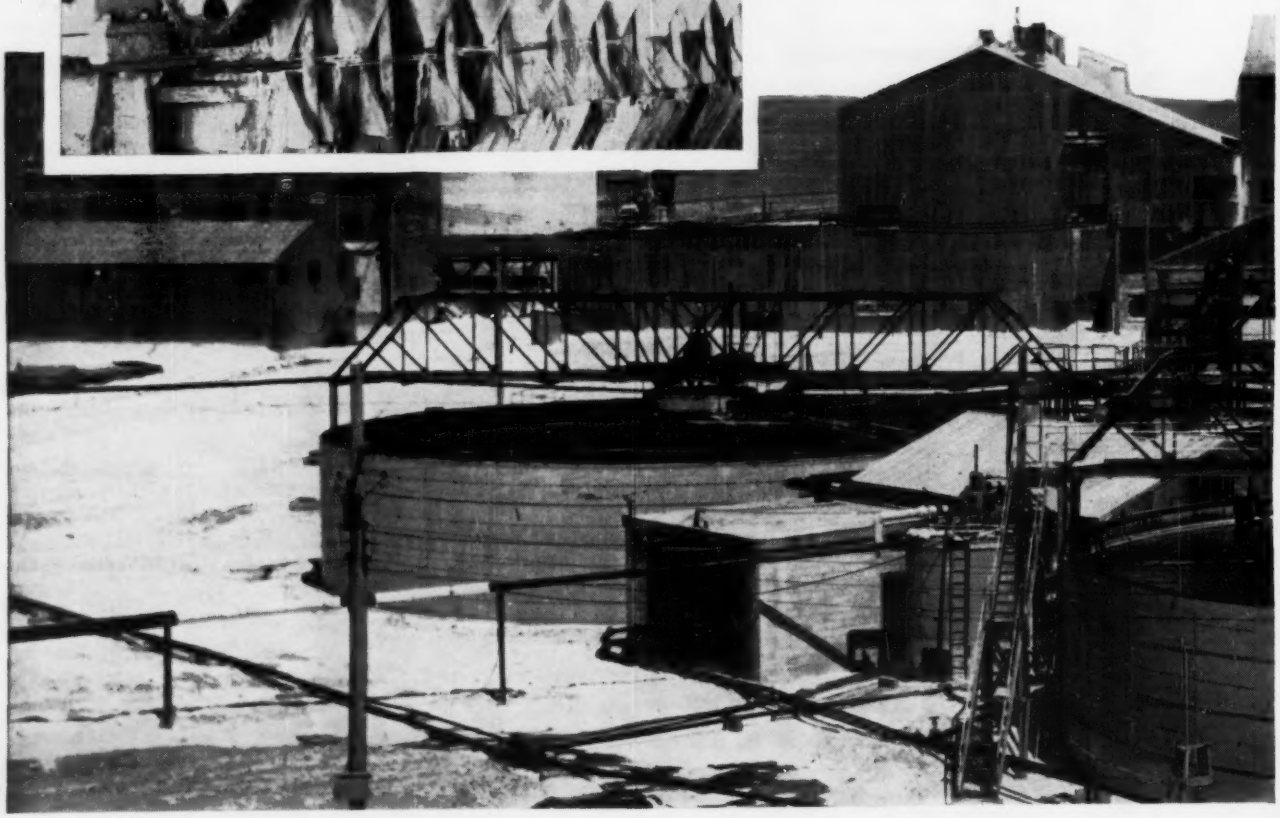
INTERMOUNTAIN CHEMICAL COMPANY...

(OPERATED BY WESTVACO CHLOR-ALKALI DIVISION, FOOD MACHINERY & CHEMICAL CORPORATION)



Closeup of one of the six Sweetland Filters.

General view of plant with three Dorr Thickeners in foreground.



The vast trona deposits throughout the Green River, Wyoming, area represent an assured supply of soda ash for expanding western industry. But before calcination, insolubles amounting to approximately 10% must be removed by physical means. And here Dorr-Oliver equipment and methods play a vital role.

At Intermountain Chemical Company's Green River Processing Plant, trona ore is crushed, screened and dissolved in mother liquor and a small amount of makeup water. Solution is then clarified in two 80′ dia. Dorr Thickeners. Underflows are washed free of entrained salt in a third Dorr Thickener. Combined overflow from the three Thickeners is a sodium sesqui-carbonate solution which is polished on six #12 Sweetland Filters. The Sweetlands are of cast iron construction with 72 leaves each providing a total filter area of 6024 square feet. After polishing, the solution is concentrated in triple effect vacuum crystallizers. The resulting crystals are thickened in two 30′ dia. Dorr Units and are then calcined to soda ash. Operated by Westvaco Chlor-Alkali Division of Food Machinery and Chemical Corporation, the plant has a capacity of 350,000 tons per year.

For the Process Industries, Dorr-Oliver offers a complete and integrated service. Well-designed equipment, as installed at Intermountain Chemical, is an important part of this service. But if your processing needs involve laboratory and pilot plant testing, flowsheet preparation, economic analysis or complete plant design and construction, we can also be of help. For a complete picture of the scope of the Dorr-Oliver technical service write for a copy of Bulletin No. 7003. Dorr-Oliver Inc., Stamford, Connecticut.

Sweetland — T.M. Reg. U. S. Patent Office

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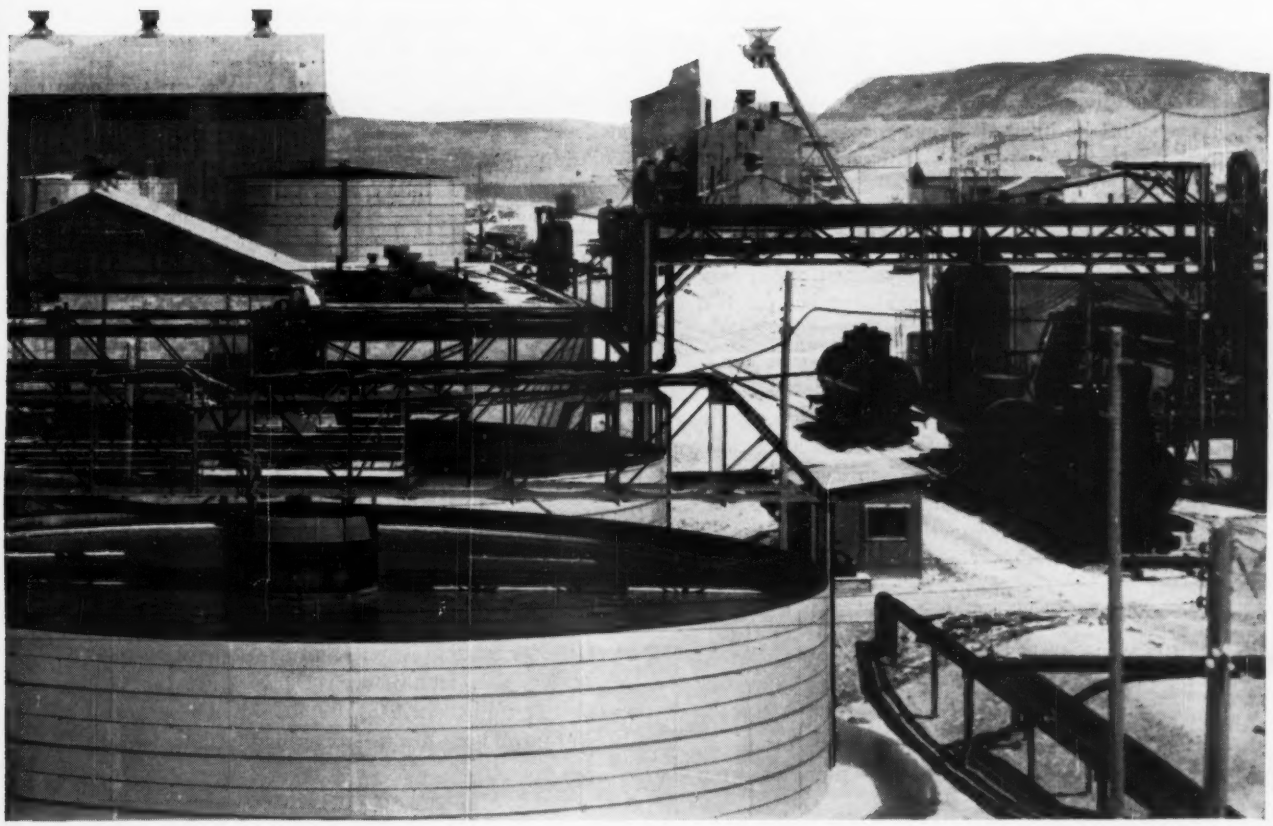

sodium and ammonia base liquors or on acid sulfite prehydrolysis liquors and it can be run continuously as part of the complete pulping cycle. Inorganic pulping chemicals are recovered for recycling, heat values in the waste liquor are recovered.

Previous methods for isolating lignosulfonates usually required time-consuming dialysis or precipitation. Rayonier just steam-strips (to remove SO_2) and adsorbs on the special, primarily tertiary amino anion exchange resin. There's no need for prior removal of pulping-based cations.

Lignosulfonates are regenerated with caustic; excess caustic and heavy metal impurities are adsorbed on a carboxylic cation exchange resin, then regenerated. Sugars, metal ions and unadsorbed lignosulfonates passing through the anion exchange column are combined with excess waste liquor for evaporation and burning.

The process recovers about 20% of total lignosulfonate values as a 15% solution of sugar-free lignosulfonic acids in a relatively narrow range of molecular weights—1,200 to 1,600. In commercial practice this solution will likely be converted to 40–60% sodium lignosulfonate.

The anion resin, is weakly basic, highly cross-linked and porous. And it's significant in its own right since this is the first big use of such a resin to adsorb high molecular weight compounds selectively over a narrow range of molecular weights. These resins should also be attractive to the drug industry, among others, where fermentation complexes must be isolated. Rayonier doesn't plan to make resins commercially, but will license its resin process.

On the market side, Rayonier feels its pure sodium lignosulfonates are entirely new products. Accordingly, its pilot plant at Shelton, Wash., is turning out only development batches for test marketing. As soon as this program determines which fractions are most likely to find ready markets, a full-scale plant will be built.

In commercial quantities, the fractions should sell for under 20¢/lb. Best potentials are as dispersants, particularly in concrete mixing, as clinker grinding aids in cement production, and possibly as a base for simpler aromatics such as vanillin.

Chemicals' new role in atomic energy

Though certainly not rushing out to take up the challenge, the chemical industry looks like far and away the best bet to come up with the technology needed to purify and recover uranium, plutonium and other radioactive products from partially used nuclear fuels.

Right now there's only one major U. S. plant doing this job. It's run for the AEC by Phillips Petroleum near Arco, Idaho. Capacity of this unit has never been disclosed, but even with recent expansion it seems unlikely that it is big enough to take care of all the partially used fuel that will be around when the nation's electric power industry starts switching in earnest to atomic power plants beginning in 1959.

So some intensive planning is mandatory. Yet only one chemical process firm—National Lead—has said outright that it intends to build such a plant. And its plans are still very tentative.

Why is chemical processing of nuclear fuels needed at all? Phillips explains it this way: "It is not posible completely to burn up the fissionable material from the fuel elements in a nuclear reactor because of the buildup of fission-product poisons and radiation damage to the elements. Economical operation of a reactor requires that the valuable unconsumed fissionable material be recovered."

How can this best be done? The answer to that one is still a big unknown, but some interesting possibilities are being tested, particularly by Phillips and Argonne National Laboratory.

At the Arco plant, Phillips first dissolves very radioactive uranium-aluminum fuel elements in nitric acid, then uses liquid-liquid extraction with methyl isobutyl ketone to separate uranium from the aluminum, fission products and trans-uranic elements present. The uranium is concentrated, then sent to another plant for further processing. Waste solutions are concentrated and permanently stored underground.

Argonne Laboratory, which helped develop the process used at Arco, is working on several other methods and described four of them at the Geneva atomic energy conference: precipitation, ion exchange, fractional distillation and pyrometallurgics. All involve chemical engineering and if any go commercial it's more than logical that a chemical company should take the initiative.

Novel machine ups paper mill output

One universal problem among paper makers is what to do with side rolls or webs—the bits and pieces trimmed off big rolls of paper—that are too narrow to be sold to the mill's normal customers. Most producers simply put these rolls back into the beaters and repulp, even though that takes up valuable mill capacity.

But now Dorr-Oliver, Inc., of Stamford, Conn.,

(Continued on page 110)

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GENERAL CHEMICAL'S Anhydrous SODIUM SULFATE

General Chemical's Anhydrous Sodium Sulfate has long had a reputation for superior quality . . . and today's product is of the highest quality available. It consistently assays better than 99.9% Na_2SO_4, more than meeting the strictest industrial specifications.

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thinks it has a better solution in the form of a new machine called the Webwelder. What it does is splice as many as five side rolls (5-in. minimum width) into one big roll up to 85-in. wide. Although the weld is visible, it's the same caliper as the rest of the roll and has the same tensile strength as unwelded stock, so the finished roll in most cases can be sold for the same price as uncut paper. Thus repulping is cut down and salable mill capacity is boosted.

All sorts of stocks have been welded successfully, including newsprint, strawboard, high-quality kraft, liner board and corrugating medium.

The Webwelder works like this: Two or more rolls are unwound at speeds up to 500 ft./min. and rotary grinders bevel the edges to be joined to just less than half their original thickness. Glue is applied to one of the two edges and they are joined and pressed together in compression rolls. Finally, the welded roll is rewound. Paper dust from the grinding operation is collected and can be repulped.

Expect these laws next year

Though the start of the next session of Congress is still way off, legislative groundwork is already being laid. And for the process industries, it looks like a full session. Among items already on the docket: water pollution, customs and world trade, chemical food additives, patent fee boosts, and, above all, taxes.

Both parties will have tax programs aimed at cutting $2-3 billion. But the individual will benefit most. If there's any corporate rate cut it won't go more than 2% below its current 52%. The Administration also will be pushing for a reduction in taxes on corporate income earned abroad from 52% to 38%. This is already enjoyed by firms dealing in South America.

There's little doubt that some form of customs simplification, which has already passed the House, will get through the Senate. But some drugs and other commodities may be exempted if "simplifications" means a big rate drop. The proposal would change the basis for assessing duties from foreign value to the importer's invoice price.

The Administration faces tougher sledding on the Organization of Trade Cooperation—successor to GATT as tariff negotiating organization. Such groups as the American Tariff League have already brought out the big guns in opposition and will do their best to exploit the new protectionist sympathies of some southern congressmen.

Otherwise politics shouldn't much influence process industry bills. Hearings will begin by February on how much power to give the Food and Drug Administration in regulating chemical food additives; some law is likely before adjournment. Broadening the present water pollution law to allow the federal government to bring offenders into court is pretty sure. And there's little doubt that higher patent fees will be aproved.

Up from the little-known

Small engineering firms are taking over a big share of chemical plant design, largely because of agressive acquisition of top-notch processes. Typical is Chemical & Industrial Corp. of Cincinnati which is making a big splash in fertilizers. Seven new plants will use one or more of its designs and deals are pending for maybe as many more.

C&I's stable of available-for-license processes now includes these, among others:

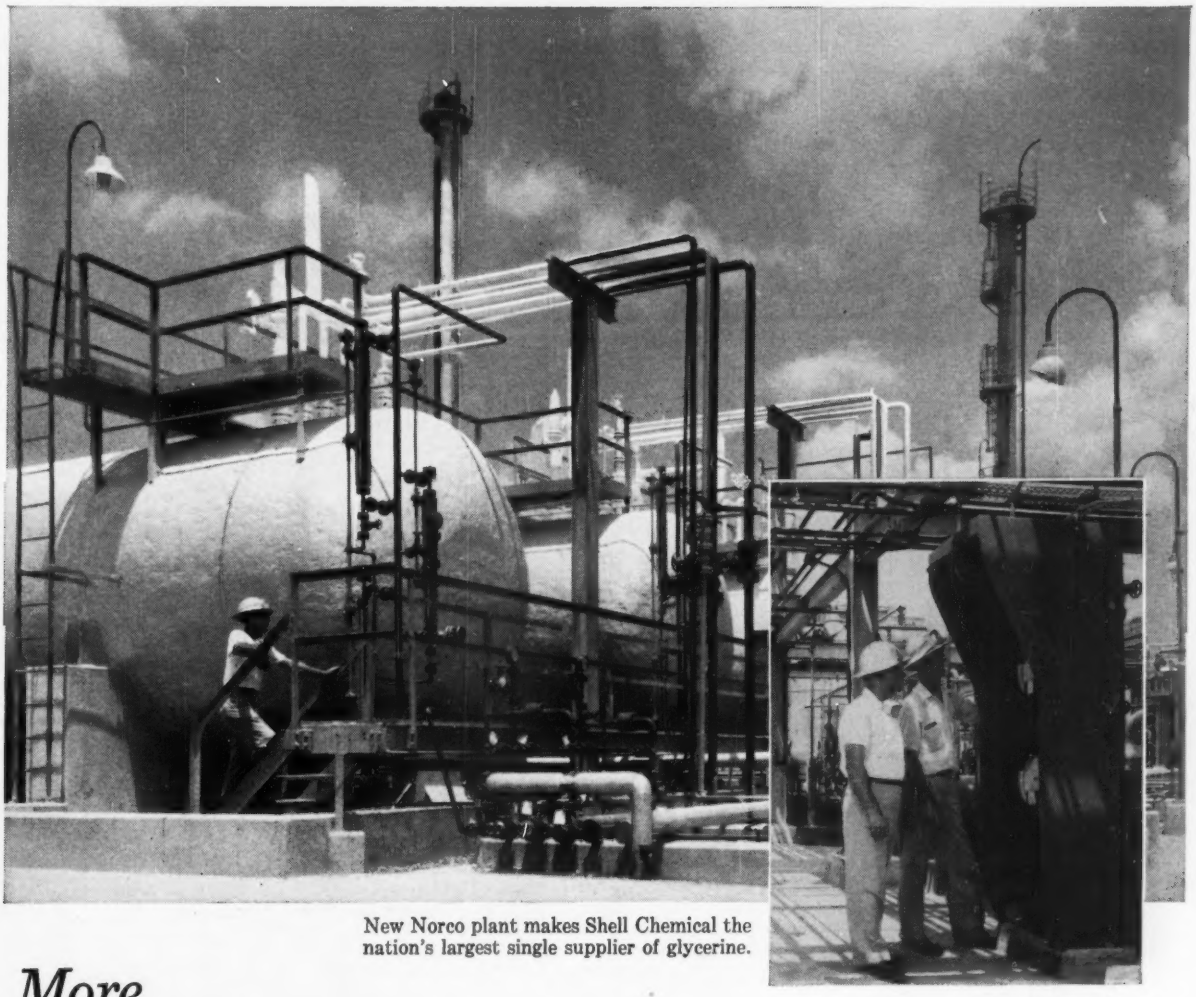
• Its own adaptation of the Du Pont-developed high pressure nitric acid process, which differs in that only one absorber and one cooler are used even in plants as big as 250 tons/day. Most nitric plants are batteries of 55-ton/day units. Also, two C&I-designed nitric plants just starting up—Mississippi River Fuel at Crystal City, Mo., and Amoniac Corp. at Brea, Calif.—will have two compressors instead of the usual one for more output flexibility. Both projects also have C&I-designed ammonium nitrate solution and prilling units.

• Exclusive U.S.-Canadian rights to the Potasse & Engrais Chimiques complex fertilizer process: Phosphoric acid is made from nitric acid and phosphate rock, then ammoniated, and KCl is added to give a mixed fertilizer with a 1:1:1 ratio. First such U.S. plant is being built for Standard Oil (Calif.) at Richmond, Calif. And C&I is designing another for Taiwan Fertilizer in Formosa, only current C&I project without a C&I nitric unit.

• Commercial Solvents' Stengel process for direct production of dry, solid ammonium nitrate from ammonia and nitric acid *(Chem. Eng.,* July 1955, p. 320). C&I shares rights to this with Ford Bacon & Davis of New York. Standard of California's Richmond plant includes a Stengel unit by C&I. And at Medicine Hat, Alta., Northwest Nitro-Chemicals' $22 million plant will use the Stengel process, too, but for solid ammonium phosphate and sulfate as well as the usual nitrate.

Rounding out the seven C&I projects are Standard Oil of Ohio at Lima, Ohio—nitric unit and nitrogen solutions unit—and Calumet Nitrogen at Hammond, Ind.—a nitric acid unit.

For more of WHAT'S HAPPENING. 112



New Norco plant makes Shell Chemical the nation's largest single supplier of glycerine.

More Glycerine *on stream!*

Seven years ago, Shell Chemical startled industry with this news . . . high-purity *synthetic* glycerine, produced from petroleum, in commercial quantities!

Now . . . more good news for glycerine buyers! A new plant (Norco, Louisiana) is now on stream, adding further to the supply of uniform, high-purity glycerine.

And looking toward the future, Shell Chemical is building a plant for *an entirely new synthetic glycerine process*, using hydrogen peroxide and acrolein as raw materials.

Whether your glycerine requirements are small or large . . . a drum or a tank car . . . Shell's key storage facilities assure prompt delivery. Write for delivery information and specifications.

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OCTOBER
1955

What's Happening

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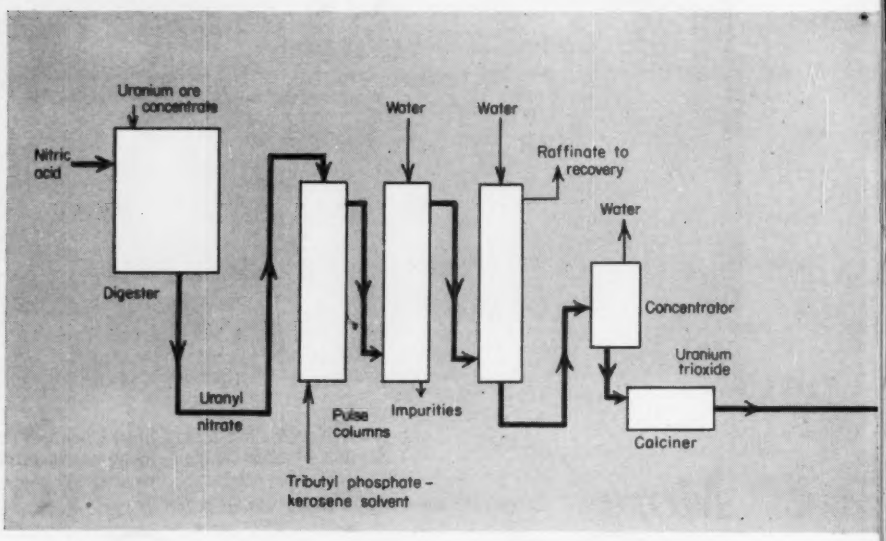
Private Firm Wants To Get Into Helium

Even as the government revealed its intention to build a fifth helium plant (at Exell, Tex.), a new firm, Apache Oil and Helium Corp., of Phoenix, Ariz., said that it hopes to get into the business. If it does helium users will get their first non-governmental supply in over 20 years.

Apache hit helium and natural gas while drilling for oil near Holbrook, Ariz., but cased them in at the time. Now the company's drilling more wells, hopes to find abundant natural gas. If found, the firm will build a $10-12 million ammonia plant, and helium will be a byproduct.

The government's new unit will cost about $6 million and will be able to produce 100 million cu. ft. of helium annually. Total U. S. helium capacity now is only 200 million cu. ft., though demand is about 236 million cu. ft.—mostly for welding.



In Uranium Drama,

Uranium ore is converted to uranium metal in a large new chemical process plant at Fernald, Ohio. Here is exclusive information on how the process works.

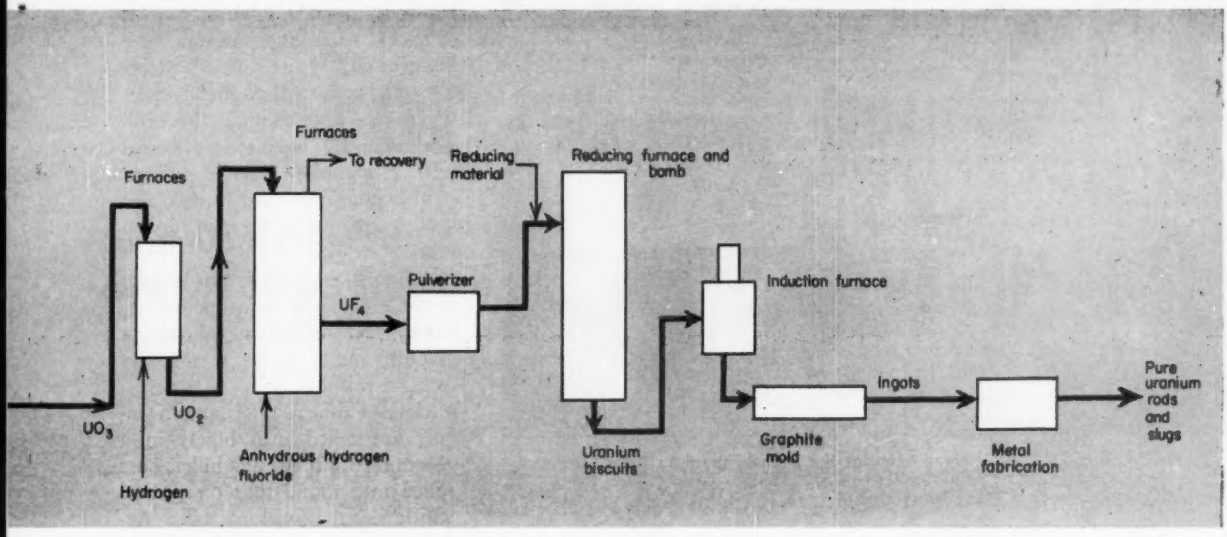
At Fernald, Ohio, near the banks of the Great Miami River, 14 miles northwest of Cincinnati, sits a large and unusual chemical plant.

Production is carried out in building covered with Transite sheathing. A high wire fence rings the operating area. Production and laboratory workers wear radiation film badges.

Until just recently little was known about what goes on inside the operating buildings, for this is the Atomic Energy Commission's $84 million Feed Materials Production Center. Operated by National Lead Co. of Ohio (a subsidiary of National Lead Co.), the plant converts uranium ore and concentrates into extremely high-purity uranium metal. This, after fabrication, is shipped to other AEC installations for use in atomic reactors.

Now, from information just released, you can get a good idea of the complexity and scope of the chemical operations that go into

in Chemical Engineering



Chemical Process Plays Star Role

the making of pure uranium metal.

As the newest plant of its type in this country,* it includes all the latest developments in uranium processing. For instance:

- A tributyl phosphate-kerosene solvent extracts uranyl nitrate in pulse extraction columns. After this, the nitrate is calcined to UO_3.
- Uranium trioxide is reduced to UO_2 in stainless steel furnaces supplied with an hydrogen atmosphere. This uranium dioxide is converted to UF_4 with anhydrous HF in Inconel furnaces.
- Pure uranium metal comes from reduction of UF_4 in a thermite-type reaction carried out in metal bombs.

But to get a better picture of just what goes on at Fernald, let's trace the flow of materials through the integrated units.

Uranium ore and concentrates† are first dried, ground and classified in jaw crushers, ball mills, hammer mills, etc.

Actually, in addition to providing ground ore for the refining operation, this step provides a point for the taking of official samples—they form the basis of payment to vendors.

▶**Purifying the Oxide**—First the ore is digested in nitric acid and this feeds into a pulse-type stainless steel extraction column, where further purification is carried out.

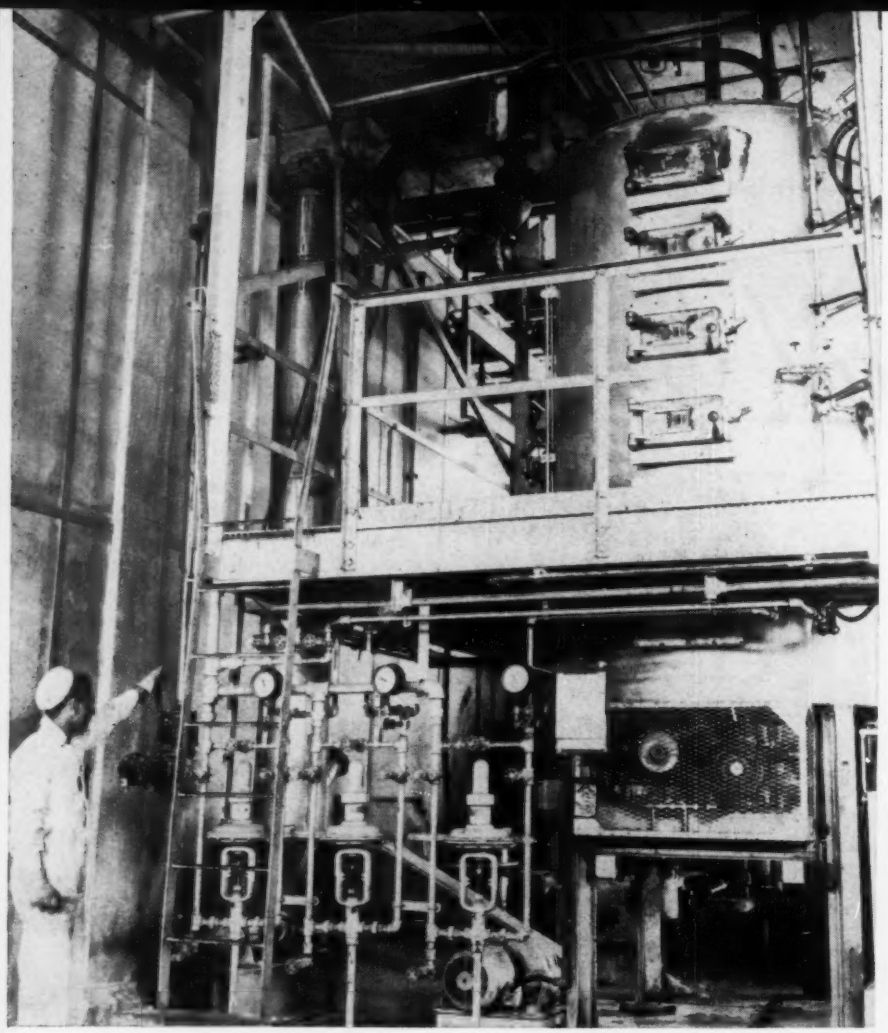
The TBP-kerosene solution is added at the bottom of the column and flows upward countercurrent to the aqueous feed.

In the column, crude aqueous uranium solution and solvent go through horizontal, stainless steel sieve trays. The pulsing pump creates a large amount of turbulence, producing a large interfacial area for extraction of uranium.

The extract then enters a scrubbing column where a small amount of water is added to remove soluble impurities. Next, in a stripping column, a large excess of water

* One other plant started operating in 1943 at St. Louis, run by Mallinckrodt Chemical Works for the AEC. Fernald has been in operation since 1953.

† Usually concentrates are made at the mine, by crushing, roasting, leaching and precipitation.



TYPICAL PRODUCTION equipment at the Fernald uranium plant.

strips the uranium from the solvent.

The aqueous solution of uranyl nitrate is concentrated and calcined to produce uranium trioxide (UO_3).

Raffinate from the extraction step is concentrated and spray calcined to recover all the nitric acid values and to recover the various metals as dry, powdered oxides. All nitrate values from this operation, as well as from the boildown and calcination of the uranyl nitrate, are collected and transferred to the nitric acid recovery system unit.

▶ **Making Green Salt**—At the green salt unit, UO_3 is converted to uranium dioxide (UO_2) by reduction with hydrogen. This is then converted to uranium tetrafluoride (UF_4, green salt) by treatment with anhydrous hydrogen fluoride.

Stored in mobile hoppers, the UO_3 is transported to the top floor of the unit and fed through a four-high series of horizontal furnaces. The top furnace is made of Type 347 stainless steel. Reduction of UO_3 to UO_2 is accomplished at elevated temperatures by passing hydrogen through this furnace, countercurrent to the material flow. Hydrogen, used in quantity, is made by the dissociation of ammonia.

Then the UO_2 feeds into three successive Inconel furnaces against a countercurrent flow of anhydrous hydrogen fluoride, at elevated temperatures—producing UF_4. This UF_4 is pulverized as required, blended, and packaged.

The hydrogen fluoride, after reacting with the UO_2, contains various metallic impurities and considerable water, obtained as a byproduct of the reaction. Hydrofluoric acid is processed through two refrigeration systems. Usable acid is removed in the first of these processes as 70% HF, loaded into tank cars and returned to the supplier. In the second, reusable anhydrous hydrogen fluoride is separated and recycled. Any remaining material is neutralized prior to disposal.

▶ **Metal Production**—Reduction of UF_4 is carried out by a thermite-type reaction at the metal production unit to produce massive uranium metal.

First, the UF_4 is charged into a lined metal bomb—after blending with a reducing agent—and the bomb is capped and heated in a furnace. After the reaction, the bomb is cooled and opened. Reaction product—uranium metal—takes the shape of a uranium "biscuit." The uranium biscuits are loaded into a graphite crucible, placed in a vacuum induction furnace and heated until the metal is in molten form.

A knock-out plug at the bottom of the crucible is then opened, releasing the molten metal into a graphite mold, where it solidifies in ingot form.

▶ **Metal Fabrication**—Uranium ingots are rolled into billets in a blooming mill. The billets are rolled into round rods on vertical and horizontal finishing mills. Automatic screw machines and centerless grinders cut and smooth straightened, finished rods into finished slugs. Slugs are then cleaned and degreased in trichlorethylene, nitric acid and water. The finished slugs are critically inspected both for defects and for dimensional specifications, then delivered to other AEC sites for use as fuel elements in nuclear reactors.

▶ **Scrap Plant**—At Fernald, the scrap unit is responsible for recovering uranium scrap material from FMPC's own and other atomic energy installations. This recovered uranium is added to the ore feed. The function of the scrap unit is to crush and grind scrap material to a small size, digest the scrap with hydrochloric acid, precipitate uranium with ammonia as ammonium diuranate, and filter and oxidize the diuranate in a muffle furnace. This produces the black oxide (U_3O_8) of uranium.

DESIGNING ENGINEERS AND CONSTRUCTORS

LUMMUS

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385 MADISON AVENUE, NEW YORK 17, NEW YORK

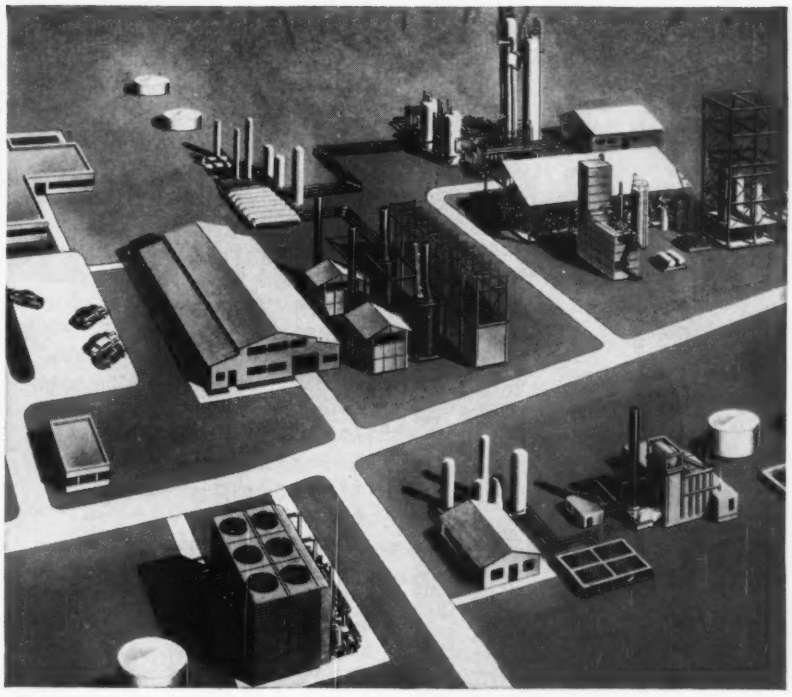
First Complete Ammonia Products Plant Planned For Puerto Rico

Lummus designed unit and will do construction

Construction will begin shortly on a new anhydrous ammonia, sulfuric acid and ammonium sulfate plant at Guanica, Puerto Rico for Gonzalez Chemical Industries, Inc., San Juan. With the creation of this industry, the second largest new endeavor on the island, another milestone is passed in the Puerto Rican Government's industrialization program.

The plant will provide a dependable source of ammonia-nitrogen and related products for fertilizer and industry of the island. This is of particular importance in times of international emergency when shortages may seriously handicap growers of sugar cane, tobacco, coffee and other industrial chemical developments.

Forty-two thousand tons of anhydrous ammonia will be produced per year. Part will be sold as such, and the balance will be converted to aqueous ammonia, sulfuric acid, ammonium sulfate and possibly other materials for use by agriculture and industry.

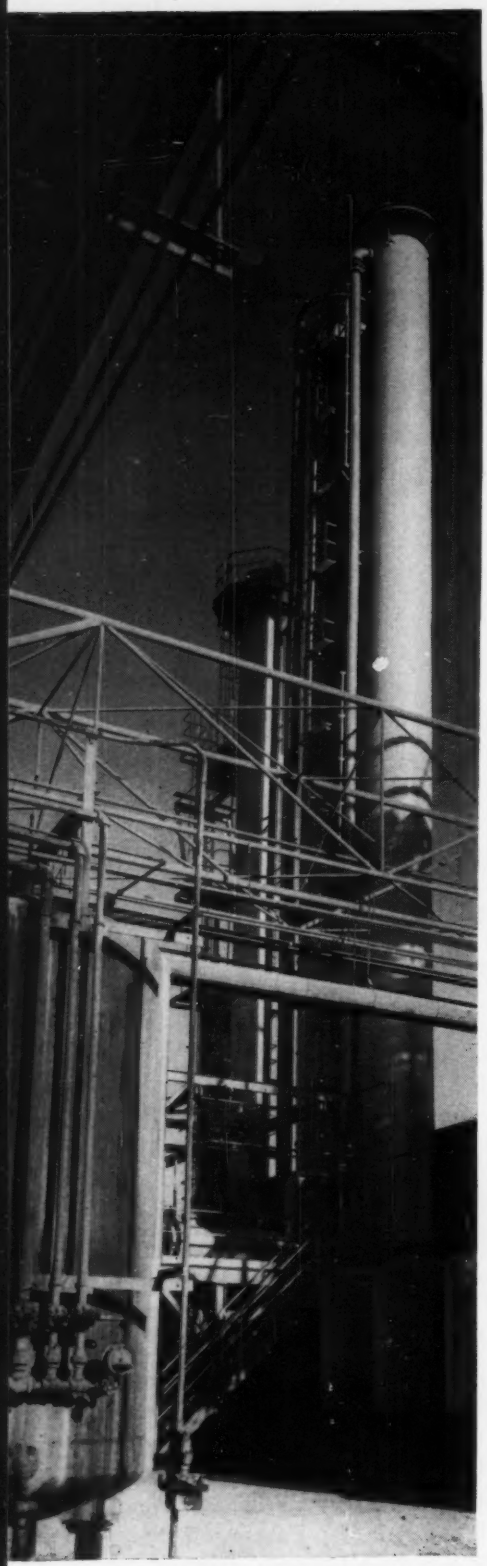


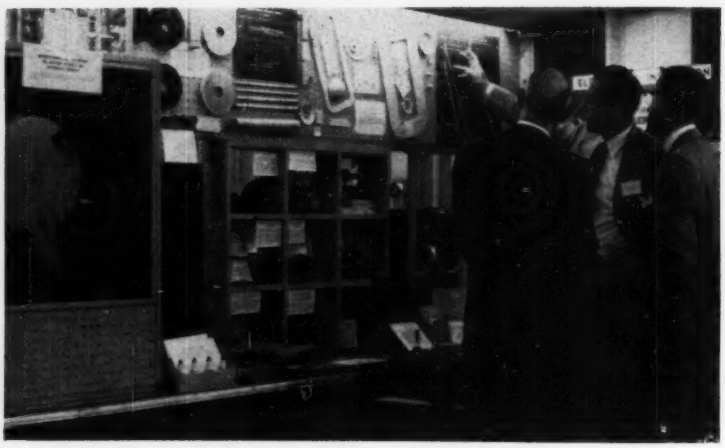
Artist's conception of complete ammonia products plant for Gonzalez Chemical Industries, Inc., Guanica, Puerto Rico.

This will make the fourth ammonia unit in two years for Lummus. It adds another to the 700-odd plants and installations completed by Lummus throughout the world. May our engineers serve you—at home or overseas?

The Lummus Company, 385 Madison Avenue, New York 17, N. Y. **Engineering & Sales Offices:** New York, Houston, Montreal, London, Paris, The Hague, Bombay. **Sales Offices:** Chicago, Caracas. **Heat Exchanger Plant:** Honesdale, Pa. **Fabricated Piping Plant:** East Chicago, Indiana.

Not only process development, but product development earn this year's honors





Dow Corning Wins '55 Award

Pioneer silicone producer is the first company to be honored primarily for the role of its chemical engineers in product and market development, technical sales.

Successful large-scale production and utilization of silicones and related products has won for Dow Corning Corp., Midland, Mich., the 1955 Award for Chemical Engineering Achievement which recognizes pioneering leadership, largely made possible by teamwork of chemical engineers in all phases of a new industry.

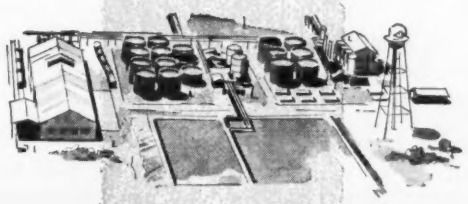
This award—sponsored since 1933 by *Chemical Engineering*—will be presented at a subscription dinner to be held in connection with the biennial Exposition of the Chemical Industries. The presentation will be made on Wednesday evening, December 7, in the main ballroom of the Bellevue-Stratford Hotel in Philadelphia.

Walter G. Whitman, chairman of the Award Committee and head of the chemical engineering department at Massachusetts Institute of Technology, will present the award. It will be accepted on behalf of Dow Corning by its chemical engineer president, Dr. W. R. Collings.

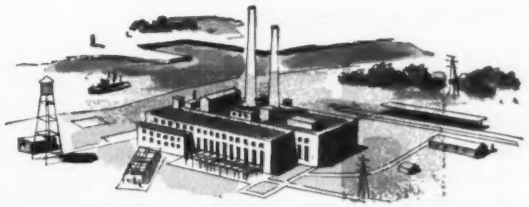
The 84-man committee is comprised of senior chemical engineering educators—department heads at those institutions whose courses are accredited by the American Institute of Chemical Engineers and the Engineers' Council for Professional Development.

This is the first time, according to Chairman Whitman, that the committee has honored a company primarily because of the successful participation of its chemical engineers in market research, product development and technical sales. The committee also recognized the contributions of Dow Corning chemical engineers to silicone process research and development.

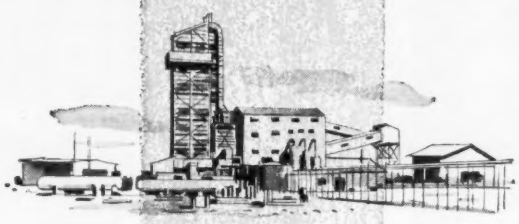
► **Rapid Growth**—Dow Corning has come a long way since the early days of World War II when research and pilot-plant production was begun on the first silicones—to develop heat-stable bonding resins



PETRO-CHEMICAL PLANT in Texas to produce ethylene from natural gas by the owner's process.



GENERATING PLANT, one of three of 66,000 KW each, installed for electric utility company in Southwest.

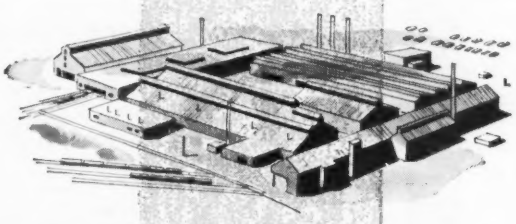


ORGANIC CHEMICAL PLANT to produce insecticides—DDT and BHC—located in the State of Alabama.

DIVERSIFICATION

AND SHARP PENCILS

PAPER MILL in the South's pine belt, increasing its capacity by nearly 500 tons of newsprint daily.



STEEL MILL facilities expanded through contract with Brown & Root in excess of $70,000,000.

More than forty years of diversified experience in engineering and heavy construction in projects ranging from $50,000 to $125,000,000 in size... has put a razor-sharp edge on the Brown & Root estimating pencil.

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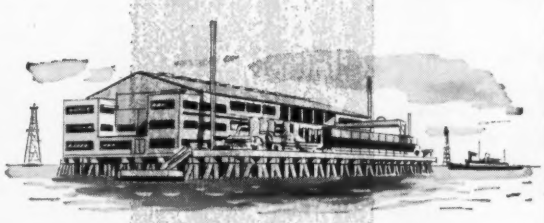
Behind each of our successful completions are arrayed the vital Brown & Root services developed by this long diversified experience... plant location data, economic surveys, design, engineering, home office supervision, cost accounting, procuring and expediting... all the cogs necessary to produce an economical, efficient facility for you. If your plans call for new construction or expansion, call Brown & Root. Plant planning experts will be put at your disposal. No obligation, of course.



PRESSURE MAINTENANCE plant for Venezuelan gas reservoir built in 62 ft. of water with 50,000 h.p.

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for use with Fiberglas in electrical insulation.

In the 12 years since its formation, the company has developed over 200 commercial organo-silicon products in the form of fluids, resins and rubbers. These were introduced and marketed to literally thousands of industrial, trade and military customers. The more important of these silicone products and their applications include mold lubricants for rubber, metal and baked goods; polishing agents for auto and furniture polishes; defoamers for lubricating oils, nonaqueous systems; finishes for textile fibers; water repellent treatments for leather, masonry and paper; resinous and rubbery materials for high temperature electrical insulation; compounds for high and low temperature rubber fabrications; and several silicone consumer products.

With this rise in commercial development has come a drop in the price of silicones of as much as 40% as well as a yearly average growth rate of 40% for the company (as compared with the annual average of 9% for the entire chemical industry and about 3% for American industry as a whole). Gross sales have jumped from $15,000 per month to over $2 million per month.

▶**Last Three Years**–A good part of this phenomenal growth has resulted from developments of the last three years, particularly in the areas of product development and technical sales.

Fifty new silicones have been commercially developed and new markets found for them. For example:

• Rubber–Improved electrical and physical properties of Silastic, Dow Corning's silicone rubber, have made the first all-silicone rubber insulation system for rotating electrical machines a practical reality. Too, Silastic can now be vulcanized at room temperature, on addition of the proper catalyst.

• Resins–Foamed silicone resin structures have been developed for possible use as foamed-in-place sandwich cores for aircraft and guided missiles.

• Water repellents–Three new water repellents are now available, which may well revolutionize textile and leather processing: Sylmer for wearing apparel and for upholstery fabrics; Sylflex, for leather, particularly for shoes.

▶**Product Development**–A look at Dow Corning's early history will show why product development and technical sales have assumed such important roles in the company's expansion.

During its first years of operation, Dow Corning depended almost entirely upon military applications to absorb its production. So great was this dependence that when World War II ended business stopped abruptly.

The temporary production setback was overcome by (1) converting intermediate products, hitherto of no known commercial value, to finished products, (2) evaluating and testing these products, and (3) educating the potential customers to the advantages of silicones. This was, in the main, accomplished through the teamwork of product development engineers and technical sales representatives –well schooled in chemical engineering and chemistry.

▶**Engineers Do The Job**–The job of the technical sales representative is to recognize potential areas where silicones can be used and to work in close cooperation with potential customers, analyzing their problems and suggesting possible solutions.

Often, customers' problems are referred to the product development engineer for devising specific silicones to suit customer needs. He is then faced with designing new methods of formulation, compounding, fabrication and testing, as well as new analytical procedures.

Significantly, chemical engineers comprise 52% of Dow Corning's product engineering department and 36% of its sales department, as well as 43% of its staff of technically trained employees.

This Award largely recognizes the contributions of these chemical engineers to the successful establishment of the silicone industry.

Convention Calendar

World Plastics Fair and Trade Exposition, National Guard Armory, Los Angeles, Oct. 5-9.

American Society of Lubrication Engineers and American Society of Mechanical Engineers, 2nd annual lubrication conference, Antlers Hotel, Indianapolis, Oct. 10-12.

National Society of Professional Engineers, fall meeting, Peabody Hotel, Memphis, Oct. 14-15.

National Metals Congress, Convention Hall, Philadelphia, Oct. 17-21.

American Society of Mechanical Engineers and American Institute of Mining and Metallurgical Engineers, solid fuels conference, Neil House, Columbus, Ohio, Oct. 19-21.

American Institute of Chemical Engineers, New York Section, symposia on cost estimation, chemical treatment of petroleum fuels and unit operations, Hotel Statler, New York, Oct. 20.

Sixth National Conference on Standards, Sheraton-Park Hotel, Washington, D. C., Oct. 24-26.

National Association of Corrosion Engineers, Northeast regional meeting, "Underground Structure Corrosion," Hotel Niagara Falls, Niagara Falls, N. Y., Nov. 1-3.

World Symposium on Applied Solar Energy, Westward Ho Hotel, Phoenix, Ariz., Nov. 1-5.

Chemical Market Research Association and Commercial Chemical Development Association, joint meeting on synthetic fabrics, Hotel Carter, Cleveland, Nov. 14-15.

American Petroleum Institute, annual meeting, St. Francis Hotel, San Francisco, Nov. 14-17.

Second International Automation Exposition, Navy Pier, Chicago, Nov. 14-17.

American Society of Mechanical Engineers, Exposition of Power and Mechanical Engineers, Coliseum, Chicago, Nov. 14-18.

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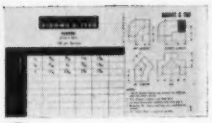

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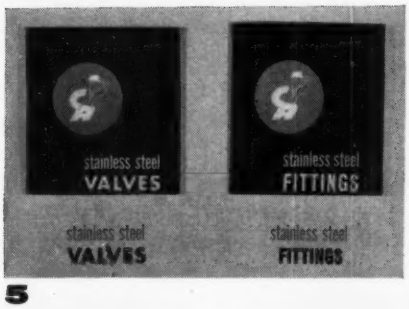

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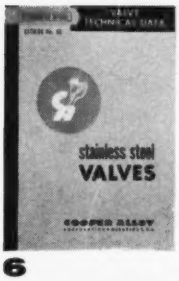

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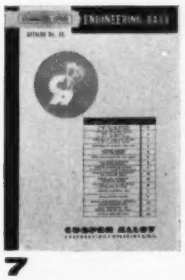

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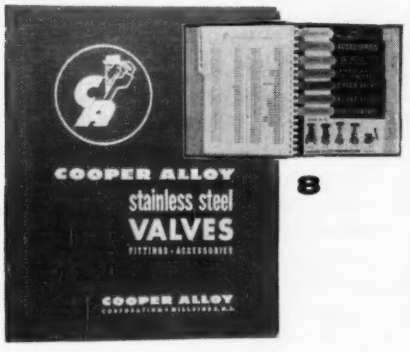

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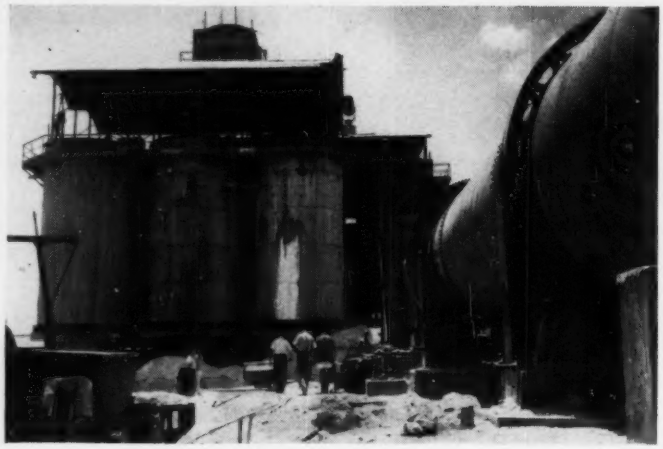

The Potash Is Good, but the Living Is Lousy

If you think you had a miserably hot summer, don't look for sympathy from the men who run this Israeli potash plant. It's set on the banks of the Dead Sea, 1,200 ft. below sea level, where summer temperature averages 104 F. and where there's hardly ever any breeze. Water temperature in the evaporation ponds reaches 175 F.

But the hotter it gets the better, because solar energy is used to fractionally crystallize Dead Sea brine (27.3% salts). About 4,000 cal./day/sq. in. of water surface are absorbed. Just recently expanded, the plant can now turn out about 200,000 tons of potash annually, and plans are to make magnesium compounds and bromine, too.

Low-Cost Hydrocracking Improves Jet Fuel

A commercially practical hydrocracking process developed by Socony Mobil Oil Co. will be used to produce a new jet fuel of high thermal stability. Briefly, it's catalytic cracking in the presence of hydrogen at high temperature and pressure.

This hydrocracking process, unlike those used in Germany during World War II, is economical because lower pressures have been made possible by new company-developed catalysts. Another factor which helped push the process within commercial reach: the availability of low-cost byproduct hydrogen from catalytic reforming processes now used throughout the oil industry.

Jet fuel made by hydrocracking retains its stability for relatively long periods at 400-500 F. Combustion performance, heat content per lb. and hydrogen content are said to be definitely higher than conventional fuels.

Montecatini Processes For Two U. S. Plants

There's a new force to reckon with in fertilizer processes—the Italian chemical giant, Montecatini. On successive days recently the firm announced that two U. S. plants would use its processes, one for urea, one for ammonia.

Shell Chemical Corp. will use the Montecatini urea process in a new 100-ton/day plant at Ventura, Calif., that will start up late next year. The process differs from other urea techniques mainly in its type of recycle (see page 186). Unconverted gases—mostly ammonia—are flashed off the ammonium carbamate reaction product by a slight pressure reduction, then condensed in liquid ammonia and recycled as a liquid without need of compressing.

Montecatini's ammonia synthesis (the Montecatini-Fauser process) will be used in the new U. S. Steel Corp. plant going up at Geneva, Utah. This plant is being designed and built by Blaw-Knox and will get its hydrogen from coke oven gas by the Linde low-temperature separation. Capacity planned is 200 tons/day of anhydrous ammonia.

Methane Synthesized From Synthesis Gas

Synthesis of methane from synthesis gas has been accomplished by Bureau of Mines researchers at Bruceton, Pa. Their bench-scale work was with partially leached nickel alloy catalyst, and was performed as a part of the Bureau's continuing research into gasification of coal to produce a commercial fuel to replace natural gas in case reserves do not prove adequate.

Key to high yield and high throughput is careful temperature control of the fluidized catalyst. This was done by injecting the synthesis gas into the reactor at several points, rather than at just one. The same catalyst was recycled several times, with full activity being restored to it between runs by further acid leaching.

New Celanese Plant For TCP, Plasticizers

Construction on a new chemicals plant for Celanese Corp. gets underway this month at Gallipolis Ferry near Point Pleasant, W. Va.

The plant will produce tricresyl phosphate, plasticizers, fire-retardant hydraulic fluids and compounds for the automotive and aircraft industries, plus a range of intermediates. Some of the raw materials will come from the company's basic petrochemical plants in Texas. Target date for completion is April 1956.

Alkane
(Basic material in manufacture of surfactants)

Detergent Slurry

Detergent D-40

Detergent D-40SF

SURFACTANTS

Detergent D-40FG

Detergent D-60

Wetting Agent S

Dispersant NI-W

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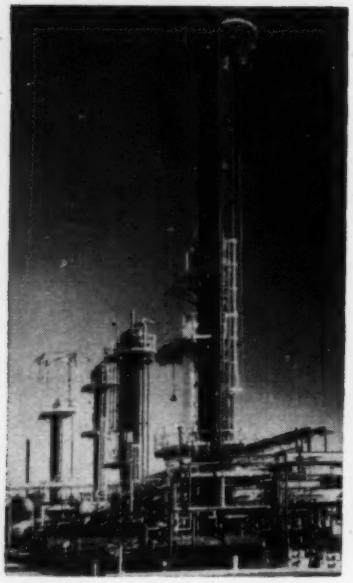
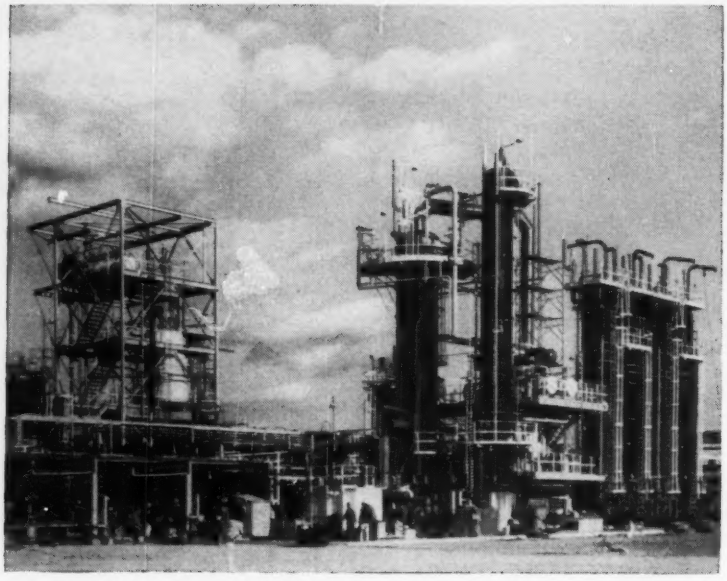
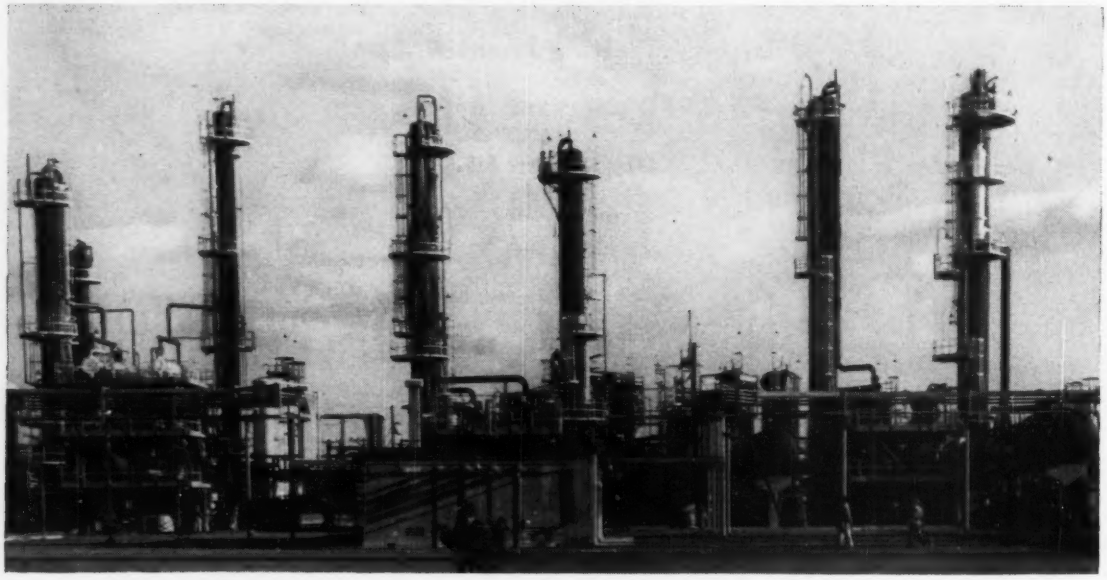


ALKYLATION: Cumene is made from propylene (ex LPG) and benzene.



OXIDATION AND CLEAVAGE: Cumene is first air oxidized (right). Concentrated cumene hydroperoxide is then cleaved with acid catalyst (left).

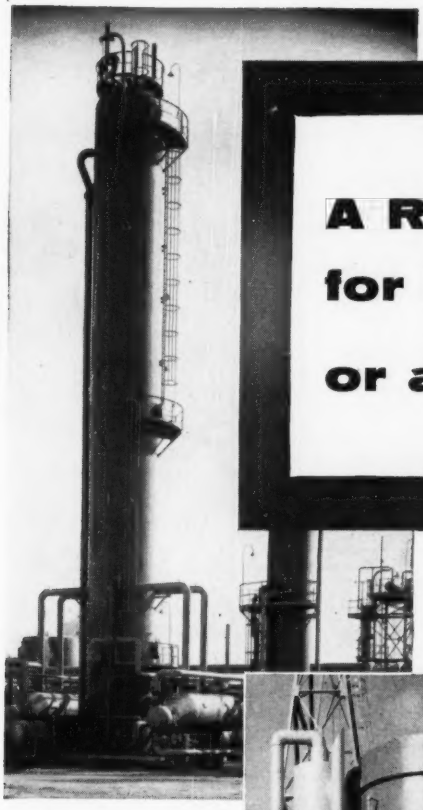


DISTILLATION: After neutralization, cleavage products are fractionated to acetone, phenol, α-methyl styrene and acetophenone. For maximum purity, phenol is further refined in glass and nickel equipment.

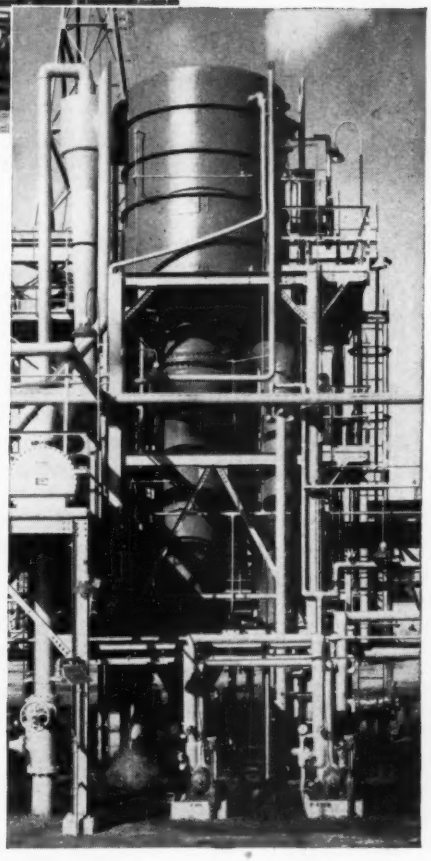
More Phenols Via Hercules Oxidation

With phenol now in full production at the Gibbstown, N. J., cumene oxidation plant, Hercules Powder is now considering the possibility of producing a variety of related products (cresols, isopropyl phenols, resorcinol, β-naphthol). Right now 26 million lb. of phenol, 15.6 million lb. of acetone, 2.6 million lb. of α-methyl styrene and 1.56 million lb. of acetophenone is made yearly at Gibbstown.

In late 1956, Hercules will add a new product to this roster—p-cresol from p-cymene. A new unit, now under construction, is expected to have a yearly capacity of 3 million lb. of p-cresol.



A Reactivator tower for Monoethanolamine... or a Urea Concentrator...



...a pressure vessel or a storage tank... Chicago Bridge & Iron Company is building them throughout industry today. CB&I is a specialist... with strategically located plants staffed to design, engineer, fabricate and erect welded steel plate structures to meet the most exacting requirements. Our plants are equipped for stress relieving and X-raying and have facilities for pickling and painting fabricated material.

When planning welded plate structures of any sort, be sure to write Chicago Bridge & Iron Company's nearest office. They will provide information, estimates or quotations.

Top left: 10-ft. 6-in. diam. by 87-ft. 6-in. high monoethanolamine (MEA) reactivator, fabricated by CB&I for the Grand River Chemical Division of Deere and Company at Pryor, Oklahoma.

Lower left: Conkey single effect evaporator of the vertical tubular type, all stainless steel construction, for production of high concentration urea liquors for subsequent "Prilling".

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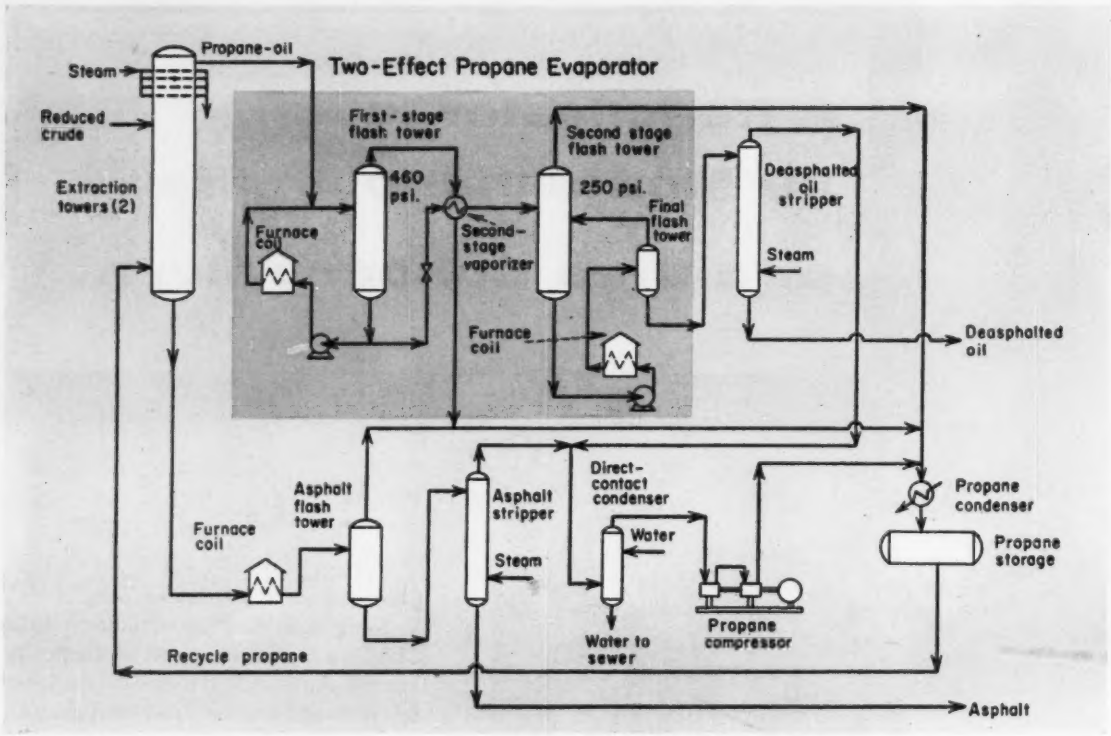


Two-Effect Propane Evaporator Cuts Fuel Bill

Petroleum refinery uses double-effect evaporation in new propane deasphalting unit, saves nearly 40% in cost of fuel and reduces cooling water consumption.

Multiple-effect evaporation, the chemical engineer's favorite tool for concentrating aqueous solutions, is now being put to use in an all-hydrocarbon system.

A double-effect evaporation system is removing propane from deasphalted oil in a new unit at the Pernis, Netherlands, refinery of N. V. de Bataafsche Petroleum Maatschappij, a member of the Royal Dutch Shell group. Said to be one of the world's largest propane deasphalting units, it is designed for a maximum oil charge rate of 12,000 bbl. per day and a propane circulation rate of 97,000 bbl. per day.

An impressive savings in fuel—approaching 40% of that required for a single-stage system—provided the incentive for development of the double-effect system. High propane-oil ratio, large scale of operations, high value of fuel in Holland—all make heat economy particularly important. Savings in cooling water consumption are also significant.

▶ **How Does It Work?**—The solution of deasphalted oil in propane from the extraction towers (see *flowsheet*) enters the first-stage flash tower. This tower operates at about 175 F. and 460 psig. Approximately 40% of the propane to the system is evaporated here.

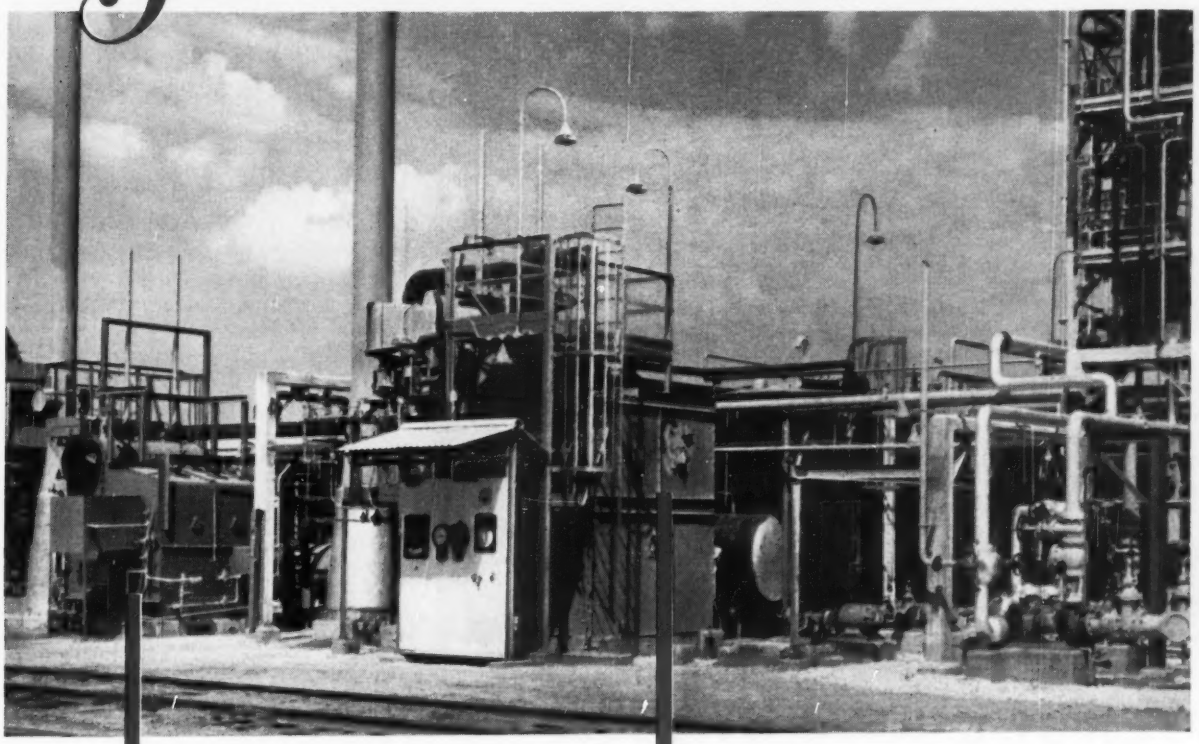
Heat is supplied by circulating a portion of the liquid from the bottom of the tower through a furnace coil, analogous to the familiar forced-circulation evaporator with external calandria.

The other propane and oil stream from the bottom of the first-stage flash tower is reduced in pressure to 250 psig. and then flows through a heat exchanger to the second-stage flash tower. Reduction in pressure before entering the exchanger permits vaporization in the exchanger of about 58% of the total propane at a temperature of 145 F., with the heat supplied by condensation of propane vapor from the first-stage.

The liquid stream leaving the bottom of the second-stage flash tower contains about 2% of the total propane. It goes through a furnace coil and a final flash tower, which operates at 400-450 F. and 250 psig. Vapor from this tower is piped back to the second-stage tower.

Vapor from the second-stage

at **Jefferson** *Chemical Company's Neches Plant*

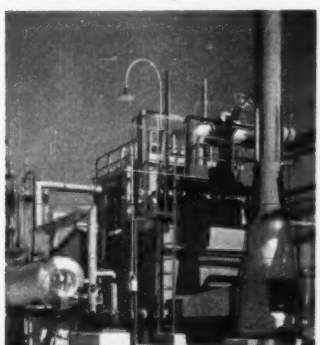


FW 3,700,000 BTU DOWTHERM UNIT

puts the heat on

Ethylene Oxide—Ethylene Glycol Production

This 2,300,000 btu Dowtherm unit by Foster Wheeler served the original ethylene oxide-glycol unit at Neches. After this was expanded, the 3,700,000 btu unit went on line, and the smaller Dowtherm vaporizer was removed and installed at Jefferson's Austin Laboratories as shown in the photo below.



Here, at the Neches plant of the Jefferson Chemical Company, large amounts of heat, at closely controlled temperatures, are required for the quality and quantity production of ethylene oxide and ethylene glycol.

All high-temperature, low-pressure heating requirements at this Jefferson plant are supplied by the 3,700,000 btu Dowtherm unit shown above — designed, built and installed by Foster Wheeler.

Wherever you need industrial or process heating, with pinpoint temperature control in the 350F to 700F range, low-pressure Dowtherm systems by FW offer many important advantages. And only FW does the *complete job*—from design and installation to operation and servicing. For information on Dowtherm installations, send for your copy of Bulletin ID-54-5. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

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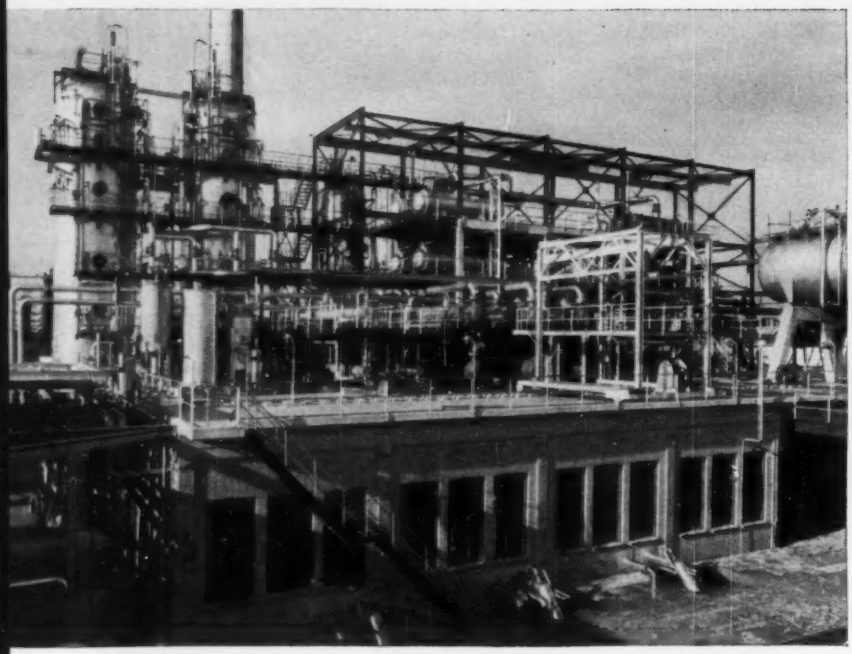


DEASPHALTING unit, at Pernis, Netherlands, is one of world's largest.

tower and condensed propane from the interstage exchanger are combined with propane streams from elsewhere in the unit for final condensation at 120 F.

►**It Works Fine**—Practicability of the double-effect system has been proven in operation over the past nine months. A triple-effect system was investigated in the early stages of design, but its incremental advantages over the double-effect system were not sufficient to justify the extra investment.

Process engineering of the unit was carried out by Stone & Webster Engineering Corp., Boston, with mechanical engineering and drafting work done in London by S & W's subsidiary, E. B. Badger & Sons Ltd. Construction was supervised by BPM, using local contractors.

One of the difficulties commonly encountered in such a system operating at relatively low temperatures is the tendency of the mixture to foam, with resulting carry-over of oil or asphalt from the evaporators and contamination of the propane to the point where extraction efficiency is impaired.

Engineers of BPM and Stone & Webster collaborated to develop a system to overcome this difficulty. They gave special care to the design of the equipment and the selection of operating conditions, making provisions to permit modification in operating conditions if required.

One Fertilizer Plant Starts Up; Four Planned

A new 70-ton/day anhydrous ammonia plant has just been put in operation at Natrium, W. Va., by Columbia-Southern Chemical Corp., marking the company's entry into ammonia production. Hydrogen used is a byproduct of electrolytic chlorine-caustic operations at Natrium.

In the planning stage are four more fertilizer projects, one in the South, three in the West. Mid-South Chemical Corp. plans a new multimillion-dollar plant at Lake Charles, La., as part of an expansion program for making and selling anhydrous ammonia. Raw materials will come from nearby refineries of Continental Oil and Cities Service. These companies, through their joint firm, Petroleum Chemicals, Inc., have acquired an interest in Mid-South.

A $23 million fertilizer plant is set for Medicine Hat, Alta., by Northwest Nitro-Chemicals Ltd. (controlled by Commercial Solvents Corp.). Late 1956 is the scheduled completion date. Natural gas—7.5 million cu.ft./day—will be used to make ammonium nitrate and ammonium phosphate by the Stengel process.

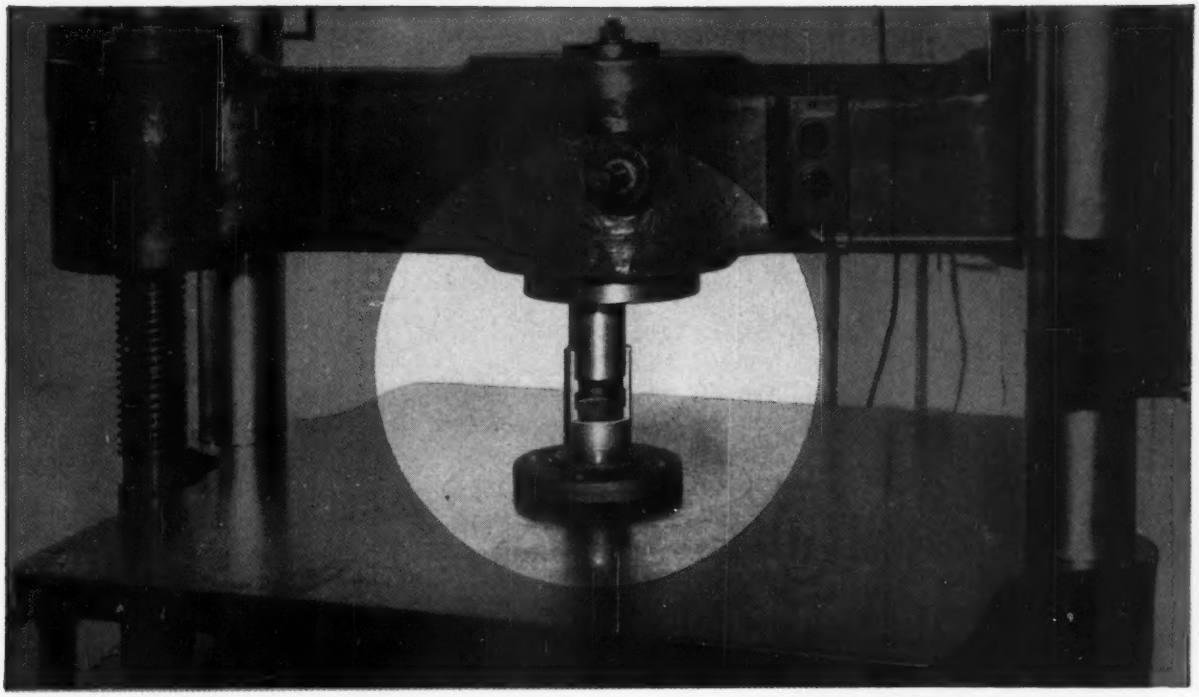
Phillips Petroleum has formed a subsidiary, Phillips Pacific Chemical Co., to build an ammonia fertilizer plant in southeastern Washington. To produce 200 tons daily of anhydrous ammonia, the first unit will go into operation late next year, getting 15 million cu. ft. of natural gas a day from Pacific Northwest Pipe Line Co., co-owner of the new subsidiary.

California Spray-Chemical Corp., a subsidiary of Standard Oil of California, has started a four-plant fertilizer project at Richmond, Calif. Production will begin next summer and will include anhydrous ammonia, aqueous ammonia, ammonium nitrate solutions, ammonium sulfate and high-analysis pelleted fertilizers. The pelleted fertilizer plant, which will use the French Potasse et Engrais Chimiques process, is the first of its kind outside Europe.

Two Gulf Oil Units Go on Stream

At Port Arthur, Tex., Gulf Oil Corp. has started up two major production units, one for refining, one for petrochemicals.

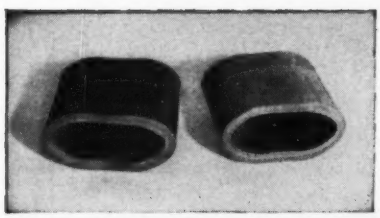
First to get into operation was a 220-million-lb./yr. ethylene plant which more than doubles the company's capacity and adds about 10% to total U. S. capacity. Then, within three weeks of this opening, Gulf started up a new catalytic reformer rated at 29,000 bpd. Designed by Universal Oil Products Co. and erected by Fluor Corp., the installation is the biggest of its type in the world. Initial catalyst charge to the unit cost about $800,000.



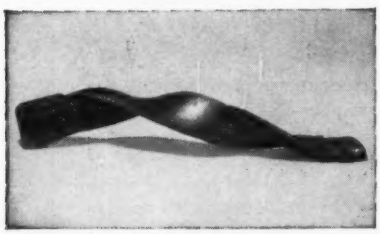
Bond holds despite shear exerted by mandrel on lead lining in test section of "Tubond" pipe.

Now...in "Tubond" pipe...a bond stronger than the tensile strength of lead

National Lead's improved bonding process inseparably weds lead to steel



Squeeze it, abuse it . . . no breaks appear in the casing, lining, or bond.



Twisted once, twisted twice . . . the second time in the reverse direction. No bond failure.

Twist it. Crush it. Manhandle it.

You just can't strip the lead lining away from National Lead's "United Tubond"® lead-lined pipe. The lining will "give" but not the bond.

Look at the test above. Here a mandrel, sized to the ID of the steel pipe minus a few thousandths, is forced through "Tubond" pipe. (A part of the side wall is cut away to show what happens.)

The lead flows, of course, and accumulates below the mandrel. But it doesn't actually pull away from the steel pipe. A thin layer of lead still remains bonded to the steel.

Now look at the twisted and crushed sections. No separation despite massive distortion. With pressure, vacuum, heat, vibration, it's the same story . . . no separation.

What weds the lead to the steel is National Lead's improved bonding process.

Proves virtually indestructible

In service, too, this bond provides an anchorage for the lining that minimizes any chance of acid leakage.

So for maximum corrosion protection, coupled with maximum mechanical strength, specify "United Tubond" pipe. Where conditions are less rigorous you may want to look into "United" expanded lead-lined pipe.

National Lead's technical specialists will be glad to help you work out the technical details of corrosion-resistant systems . . . piping, valves, pumps, coils, tanks and other elements. Just call the nearest office below.

NATIONAL LEAD COMPANY: New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 80; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.) Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Ltd.).

New Absorber Ups Light Oil Recovery

Just one spray-type absorber now scrubs 10% more light oil from coke-oven gas than the two-tower recovery system previously used at the Midland, Pa., works of Crucible Steel Co.

Converted from one of the two 100-ft.-high absorption towers that comprised the old installation, the new unit, designed by Rust Engineering Co., Pittsburgh, Pa., gets optimum contact by circulating the wash oil at a high velocity with pumps. Extra horsepower is compensated for by relatively low requirements for carrying countercurrent coke-oven gas through the system. A mist-separation section prevents carry-over of liquid wash oil in the gas.

Efficiency advantages of the new absorber are credited to design-emphasis on the following: low concentration of liquid hydrocarbons in the gas; the large volume of coke-oven gas, averaging 36 million cu. ft. per day. Due to excessive pressure drop, the old two-tower system, packed with steel turnings, could not handle all the gas produced when the coke ovens were in full production.

Steps Taken to Ease Freight Car Shortage

If you've been getting late shipments this year, there's a good chance that you can blame the shortage of freight cars. Just nine months ago there was a daily surplus of 67,000 freight cars—box, open hopper and covered hopper. Today there's a shortage of 10,000 cars a day. Main reason is that the railroads, with carloadings running 10-12% over 1954, didn't keep up with repairs during the first half of 1955.

But something's being done about it and the situation should be eased by the end of this year. An average of 6.4% of all freight cars are now unserviceable and waiting for repairs. To correct this, the Association of American Railroads has adopted a stepped-up program of repairs and upgrading, aiming to bring the total of unserviceable cars down to below 5%. In effect, this would add 25,000 cars a day to service.

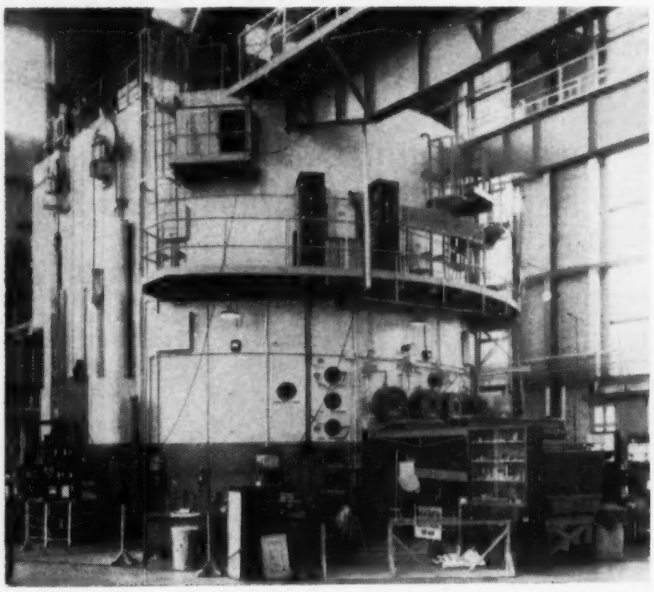
Admittedly this is a stopgap program. For the longer range, some 55,000 cars, costing $450 million, are now on order; first delivery will begin late this year, though the bulk won't be ready until the spring of 1956.

Leaders Urge New Plan For Engineers' Center

Twenty-one leading educators and industrialists have proposed a plan to eliminate obstacles in relocating the national engineering societies' headquarters in line with the best long-range interests of the profession and the nation.

In a letter to the United Engineering Trustees, Inc., and the five major professional engineering societies, the group offers to organize a nationwide drive to obtain the $2.5 million needed to replace the outgrown Engineering Societies Building in New York City. This would free the societies from depending on subsidies offered by various cities that want the headquarters.

The letter further suggests that an independent management or engineering firm be chosen to make a comprehensive study of the relocation problem. Cost of the study would be defrayed by some of the signers.



Canada Pushes Atoms for Peace

Here's one of the most detailed pictures of an operating atomic research reactor yet released. Dubbed the NRX reactor, it's run by the Canadian government at Chalk River, Ont., for production of radioisotopes and to find ways to use heat released by reactors.

At right are ports for insertion of samples for neutron bombardment studies. Below the counterweights on the left is one end of the thermal column (most of which is inside the reactor). It's used to reduce velocity of neutrons to thermal speeds.

A Separating Force
Up to 62,000 x gravity
at your command

The Sharples Laboratory Super-Centrifuge develops the highest centrifugal force commercially available (up to 62,000 x g). This tremendous separating force enables you continuously to recover solids from liquids, clarify liquids, or separate two immiscible liquids—more rapidly and more completely than by any other means. Even extremely tenacious emulsions stabilized by fmely divided solids are easily broken under this extreme force.

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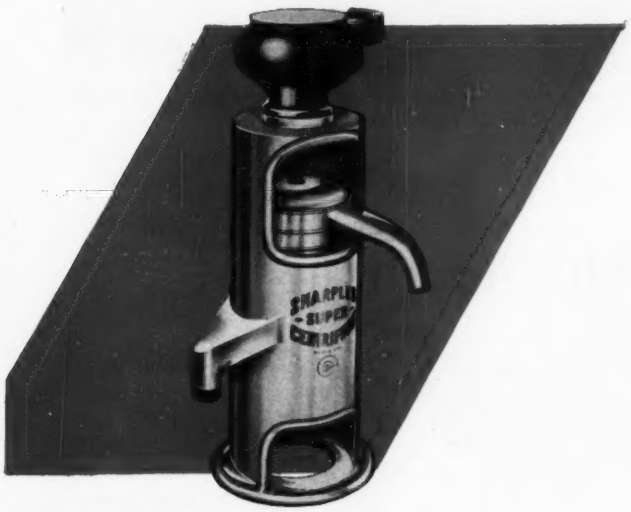
Put the highest centrifugal force commercially available to work in your laboratory or plant.

Complete details are given in Sharples Bulletin 1269 which will be sent for the asking.



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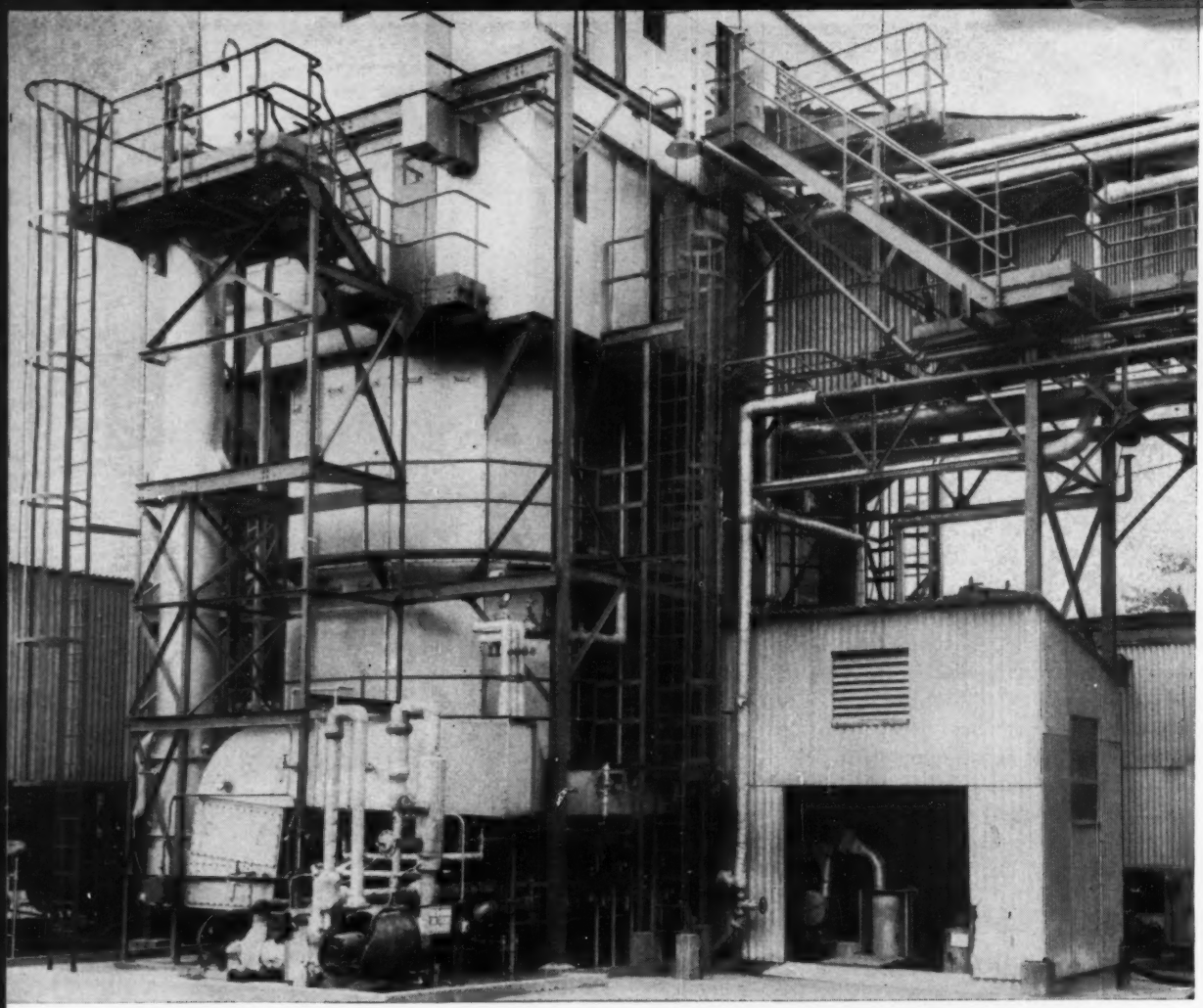


SOLVENT-RECOVERY dryer with inert gas generators and condenser at the left, vent gas blower and reheater at center, solids discharge at right. Dry product is screw-conveyed from this point to the feed building.

TREND DEVELOPING TOWARD . . .

Desolventizing Solids With Air Dryers

But leave out the air if you're looking for safety, and replace it with inert gas. A condenser will recover the solvent, instruments monitor safety.

Suppose your process yields a solid wet with a flammable solvent. The solid must be dried, and the solvent recovered. How would you do it? Of course, the answer may be conditioned by characteristics of the solid and the solvent, but in general you will want to:

- Separate the solvent as far as possible by *mechanical* means—filter, centrifugal, mechanical press, or draining device.
- Remove the remaining solvent down to some low and acceptable concentration by *thermal* means—in some form of dryer operating with either vacuum or a carrier gas to sweep away the solvent vapor as it evolves.
- Get the solvent back into liquid form, prior to final clean-up by distillation—using a method such as adsorption by a solid, absorption in a liquid, or cooling and condensation in a surface condenser.

If your choice is the carrier gas method, then you may use air, diluting the vapors below the lower explosive limit. Or you can use an inert carrier gas, and then operate with a high solvent vapor concentration in the dryer.

Chemical engineers usually think in terms of air drying, with activated carbon adsorption for the vapors. In fact, working with air as the carrier, the solvent concentration will have to be so low for safety that only adsorption—or possibly absorption—can be used in any event. But the condensation method, combined with an inert gas dryer, has quietly been developing into something approaching a

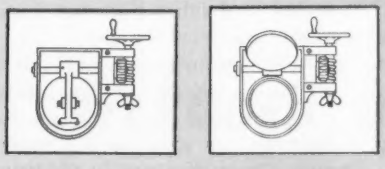
for Faster Drying

—cleaner
—dustless
—no crystal breakage

THE PATTERSON Conaform VACUUM DRYER

Faster, uniform heat transfer, plus rapid vapor removal, means today's best in vacuum drying with the Patterson CONAFORM. You get the extra values of gentle product handling, exceptional ease of cleaning into the bargain. Write for our new CONAFORM DRYER BULLETIN—detailed, free!

Richard L. Cameron
President



VACUUM TIGHT *DUSTLESS* DISCHARGE VALVE

Specially-designed discharge valve is vacuum-tight, dustless, full opening, easy to operate. Unobstructed flow speeds emptying—no grooves to trap materials—sleeve attachment permitted.

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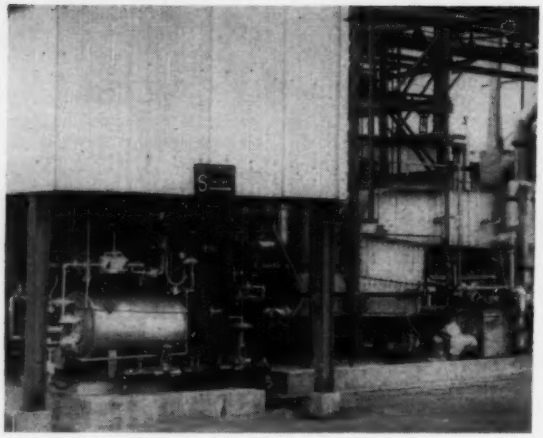
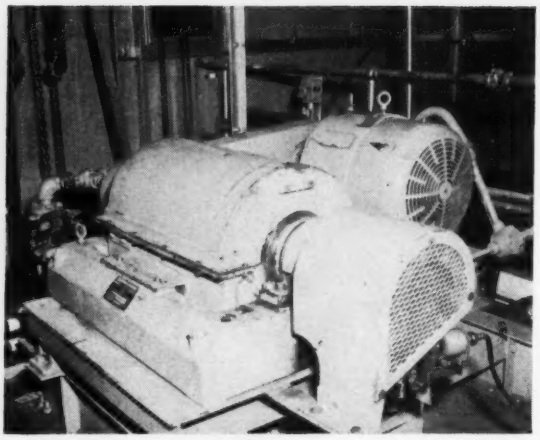


INERT gas from these generators keeps operation safe.



MYCELIA are separated to 60% solvent with this centrifugal.

trend. Several such installations, most of them quite recent, have convinced the Wyssmont Co.—Long Island City maker of the Turbo dryer—that such a trend is actually building up in cases where the solvent can be condensed at available cooling water temperatures.

Impetus behind this trend lies chiefly in the simplicity and controllability of the process. Beyond the dryer, about the only added equipment will be:

- The inert gas generator—a small one, since very little inert gas is required.
- A condenser to remove the bulk of the solvent from the circulating inert gas mixture.
- A mist separator after the condenser to remove entrained condensate.
- An external reheater for the solvent-denuded recirculated gas.
- An inert-gas vent blower and small carbon adsorber for vented inert gas.
- Safety instrumentation to check oxygen concentration in the dryer and solvent concentration in the dried material.

Whatever the method, the recovered solvent will almost inevitably require distillation to ready it for re-use, so the still cannot be charged specifically against the dryer-condenser method.

▶**How It Works Out**—One recent installation which points up this method is in Lederle Laboratories' Aureomycin plant at Pearl River, N. Y. Aureomycin is Lederle's trademark for chlortetracycline, one of the principal products of this American Cyanamid division. Like other present-day antibiotics, it is made by mold growth in deep fermenters, followed by eventual separation and solvent extraction of the fermentation mycelia. The fermentation produces Aureomycin, and with it a small amount of vitamin B-12. This component remains in the mycelia along with a controllable amount of Aureomycin. After drying the solvent-wet mycelia to remove virtually all its solvent, the product becomes a valuable livestock feed component. Not only does it serve as a growth factor, but it also helps to maintain the animal's health.

Although the solvent could be displaced from the mycelia with water, and the water-wet cake dried, less heat would be required in drying the solvent-wet cake. Hence, the decision was to dry directly, rather than to displace with water. To avoid possible explosion hazards if air were the drying medium, provisions were made to use inert gas and to control at less than 5% oxygen. Possible hazard from out-leakage of the solvent vapors is avoided by operating under very slight negative pressure. The inleakage is vented by a continuous bleed of inert gas through a small activated carbon adsorber, and thence to waste. To replace this, inert gas is generated continuously by controlled combustion and drying of natural gas, and about 20 cfm. is automatically added to the system.

The dryers—there are two, but generally only one is required—are of the standard Turbo type, 23 ft. high in 15-ft. diameter casings, containing 32 annular rotating trays surrounding a number of turbo fans on a central vertical shaft. Solids deposited on any tray are scraped off once per revolution and deposited on the next lower tray. Residence time in the dryer, as material moves from top feed to bottom discharge, is about 2¾ hr. Between the outer circumference of the trays and the dryer shell are the vertical flat-tube steel heaters which provide the bulk of the heat for drying.

In operation, the inert gas circulates continually outward from the turbo fans, over the material on the trays, then over the heating tubes where it is reheated by heat exchange with steam. It then flows inward over other trays and back to the fans.

In this manner, every cubic foot of gas is reheated several times from entrance at the bottom to discharge on top, assuring maximum drying efficiency. In addition, the constant re-energizing of the gas flow by the fans means that

Shorten Your Process Time

with

U. F. CONCENTRATE – 85

(59% Formaldehyde – 26% Urea)

If your process needs high concentrations of both formaldehyde and urea use Nitrogen Division's U.F. Concentrate–85 – the highest available concentration of liquid formaldehyde–59% Formaldehyde, 26% Urea. Active content is 85% by weight.

There are many advantages:

- **Increase production in shorter time with existing equipment.**
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- **Pump U.F. Concentrate–85 using your regular formaldehyde facilities.**
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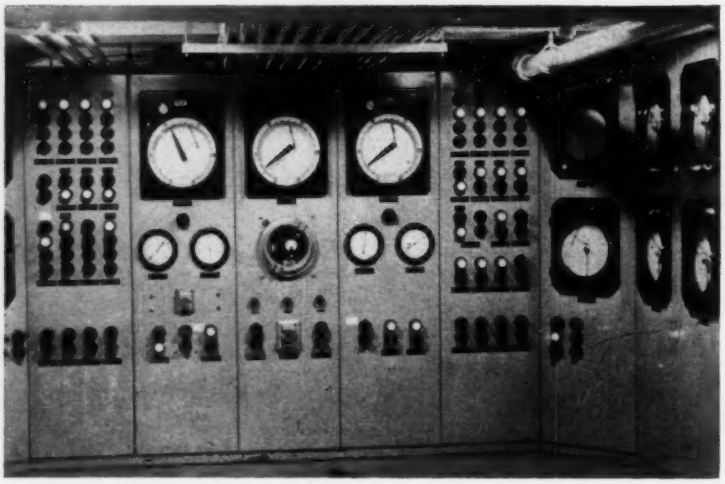

INSTRUMENTS, especially oxygen analyzers and combustible gas indicator, ensure safety of dryer operation.

there is virtually no pressure drop through the dryer.

▶ **Dryer Auxiliaries**—In addition to the dryers proper, certain other equipment is necessary owing to the type and purpose of the operation. When the dryers were first installed, the mycelia were separated by filters from the bulk of the solvent in an adjoining building. The resulting cake was conveyed to the dryers by a belt conveyor, enclosed and running in an inert atmosphere. Maintaining the belt and the inert atmosphere were both severe problems, and the method now used has eliminated these difficulties completely. The solvent-mycelia slurry from the Aureomycin building is now pumped to Sharples Super-D-Canter continuous centrifugals in the penthouse atop the dryers. Solvent returns to the Aureomycin department, while the cake (containing 60% solvent) drops directly into a specially designed Wyssmont Roto-Scoop star feeder. An automatic cleaner for the feeder pockets prevents any trouble here. Cake then drops to the top shelf of the dryer.

Circulating inert gas leaves the top of the dryer with its load of solvent vapor, passes through a fan, then flows downward through the tubes of a vertical shell-and-tube condenser. Solvent condensate is collected in a duct at the bottom of the condenser tubes, then part is directed to the distillation department for final clean-up before re-use. Most of it, however, is pumped back to the top of the condenser and sprayed into the tubes to prevent fouling of the tubes with entrained dry-product dust. The inert gas leaving the condenser bottom reverses direction and passes upward through a mesh-type entrainment separator.

Before the stripped inert gas returns to the dryer it must be preheated in an extended-surface steam heater. Just ahead of the heater, the small amount of vented inert gas is drawn off by a centrifugal blower. To replace it, new inert gas is constantly added under automatic pressure control.

As the gas spirals its way upward through the dryer, solids are meanwhile working their way downward, finally leaving with negligible solvent by way of a bottom hopper and choke screw which seals the discharge against air inleakage. As later described, it is at this point that the product is checked automatically for completeness of solvent elimination. It is then carried by screw conveyor to the feed building for further processing, blending and sacking.

▶ **Instruments and Control**—Thanks to a careful job of instrumentation, operation of the solvent recovery system requires little attendance, while safety is virtually automatic. In the inert gas system, withdrawal of vent gas automatically controls the entrance of new gas through the automatic pressure controller on the inert-gas generator. Water supply to the condenser and steam supply to the external and internal circulating gas heaters are controlled automatically by temperature. Solids feed rate to the dryers can be set at any desired value by variable-speed drives on the feeders.

Two aspects of the instrumentation apply to safe operation. Each dryer's recirculating gas load is sampled constantly by a Hays oxygen recorder of the paramagnetic type. To guard against possible instrument failure, a third oxygen recorder is automatically switched every few seconds to monitor the indications of the other two instruments. Any discrepancy causes an immediate alarm. Then, to make sure that the dried cake contains no more than a predetermined safe maximum of solvent, the atmosphere in the choke screw discharge hopper is continuously sampled by a Mine-Safety combustible gas detector and alarm. Should the safe maximum be exceeded, delivery of the product to the feed building is immediately halted, with the incompletely dry material diverted to temporary storage until the situation has been rectified.

Other automatic interlocks add still further to the installation's safety. If condenser outlet temperature goes above a set figure, automatic shut-down ensues. Failure of the inert gas supply, signalled by loss of pressure, is another cause for immediate automatic shut-down.

Although the particular solvent-recovery problem will always dictate the details of an inert-gas drying installation of this type, Lederle's set-up indicates the main outlines of a solvent-recovery method that seems destined to become more common in the future than it has been in the past.

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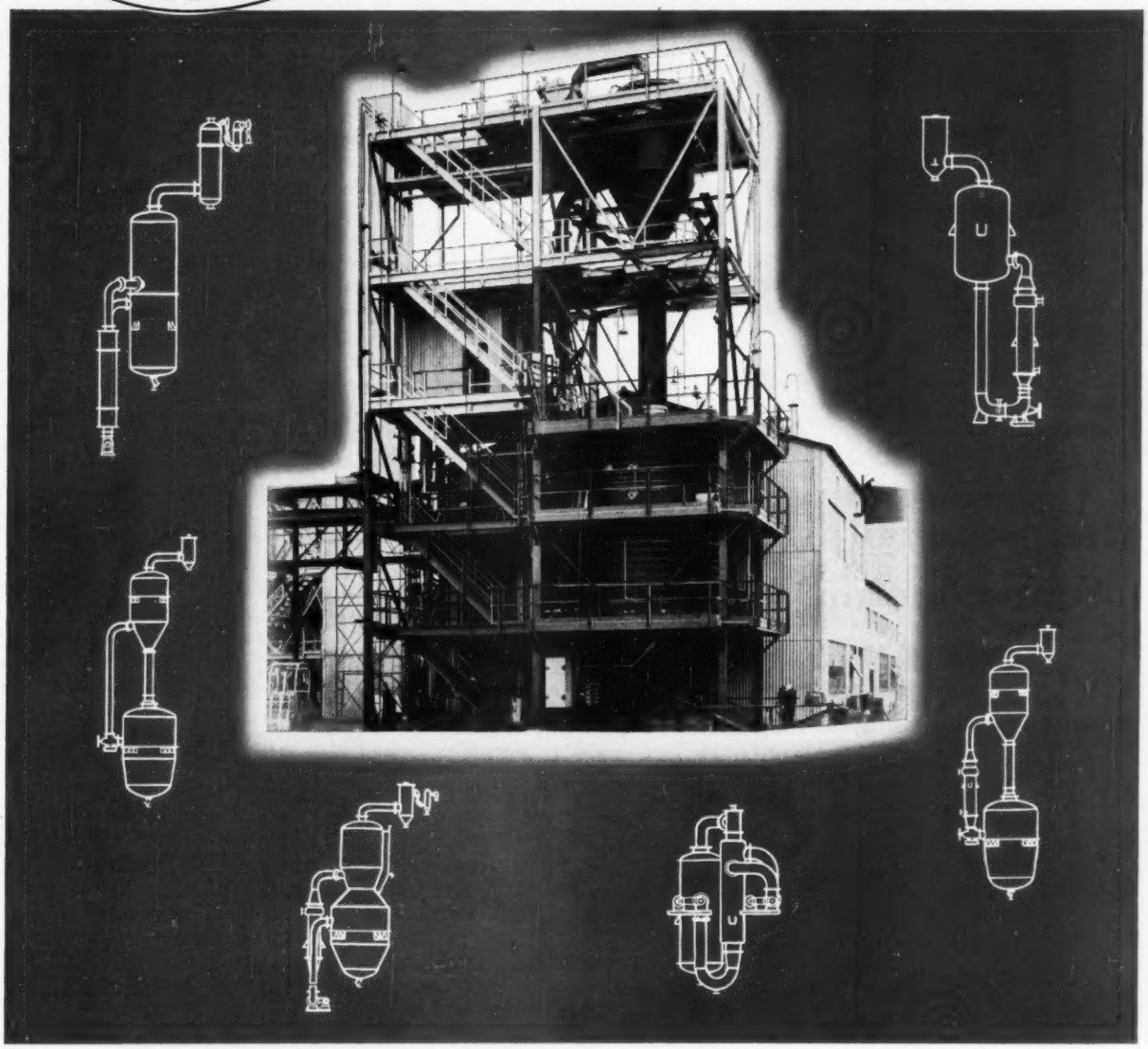
Our experienced engineers will be pleased to co-operate with you on any crystallization problem



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NEW NITROPARAFFINS PLANT:

Milestone on Uphill Climb

Production of nitroparaffins and derivatives is now reaching multimillion-pound-per-year scale after 20 years' work developing this new family of chemicals.

With a minimum of fanfare, Commercial Solvents Corp. late in August put on stream its new nitroparaffins plant at Sterlington, La., and this month will start up facilities there for making NP derivatives.

The new units at Sterlington, plus recent expansion of existing NP facilities at Terre Haute, Ind., and Peoria, Ill., represent an investment in physical plant of about $5 million.

More than mere steel and concrete, vessels and piping, pumps and instruments, the new units represent over 20 years of research and development on this unique family of chemicals, discovered in the laboratories of Purdue University in the early 1930's.

Capacity of the major NP unit at Sterlington is placed at more than 10 million lb. per year of four principal products—nitromethane, nitroethane, 1-nitropropane and 2-nitropropane. The derivatives plants can turn out desired quantities of any of several hundred products.

▶**Neat Tie-In**—Manufacture of nitroparaffins ties in neatly with Commercial Solvents' other operations at Sterlington. Other major products there are ammonia, nitric acid and methanol. Nitric acid, of course, is a basic raw material for NP's. Methanol goes into production of some of the derivatives, both as a solvent and as raw material for another intermediate, formaldehyde. Manufacture of derivatives also uses hydrogen from the ammonia-methanol synthesis-gas units.

▶**Nitrator Design**—Fundamental reaction in making nitroparaffins is vapor-phase nitration of a paraffin hydrocarbon, usually propane. One of the big problems which CSC engineers had to solve was development of suitable vaporization and reaction equipment which could be made from available materials.

Since heat must be added for vaporization and removed during nitration, the two steps were combined in the form of an adiabatic reactor. Liquid nitric acid is sprayed into the reactor; heat of reaction serves to vaporize the acid. Even this solution, simple as it sounds, encountered obstacles, requiring design of special spray nozzles and development of a special alloy to give the desired combination of corrosion resistance and physical properties.

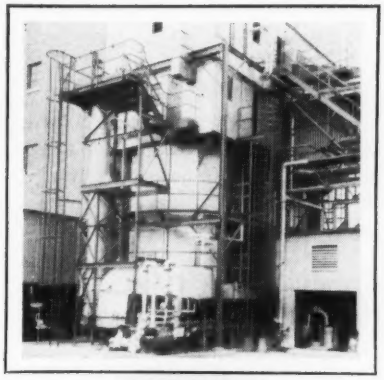
▶**Nothing Left to Chance**—Control of reaction conditions is critical. Optimum conditions for nitration lie in a narrow zone between essentially no reaction and predominantly oxidation reactions. Control panel of the NP plant contains over 100 miniature recorders and controllers, and is supplemented by a full-length, console-type, multipoint temperature installation.

A data reduction system continuously scans 70 key temperatures and at preset intervals prints the data on the plant log. Whenever there's any deviation from one or more control points, the scanner will immediately print out these data and notify the operator by means of an alarm.

Other special instrumentation includes an infrared analyzer on the nitric oxide stream, hydrogen analyzer on the reduction autoclaves in the derivatives unit and a mass spectrometer for NP analysis.

▶**Self-Sufficient**—Building on the basic chemical research work at Purdue, the entire commercial development of the NP's and derivatives has been carried out by Commercial Solvents' own engineers.

The Sterlington project was preceded by a pilot plant at Terre Haute and a semicommercial plant at Peoria. CSC engineers handled the design, drafting and procurement for the commercial plant; actual construction was by Ford, Bacon and Davis.



Turbo Dryer®

with recirculation of inert gases, conditioned air and vapors,

offers unusual advantages for

CONTINUOUS

- Low temperature drying
- Drying with solvent recovery
- Drying in inert or protective atmosphere
- Sublimation
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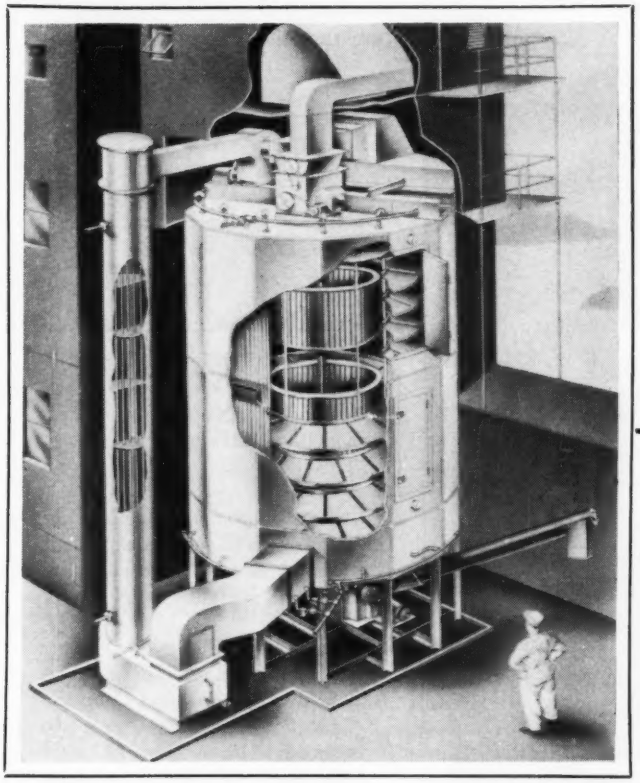
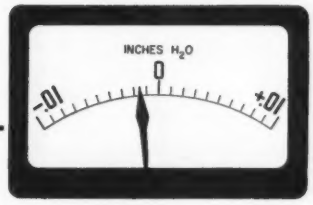
- Drying with superheated vapors



The Turbo Dryer consists of a tray rotor, centrally located turbo fans and insulated housing. The product on each tray is wiped off after the tray completes one revolution, falling on the tray below in a pile, which is leveled. From the lowest tray, the product drops onto the dryer bottom, whence it is swept into the discharge spout.



Negligible pressure drop through Dryer permits operation at slight negative pressure, hence very small gas makeup required.

ADVANTAGES

- SAFETY OF OPERATION, NO EXPLOSION HAZARDS
- DUSTLESS OPERATION
- HIGH THERMAL EFFICIENCY
- HIGH SOLVENT RECOVERY
- SMALL INERT GAS MAKE-UP
- OUTDOOR INSTALLATION
- LOW MAINTENANCE

Successful installations attest to the merits of this system.

TURBO DRYER

WYSSMONT COMPANY INC. *DRYING ENGINEERS*

DRYING • SUBLIMATION • OXIDATION • COOLING

Home Office: 42-05C 27th Street (Bridge Plaza South) Long Island City 1, New York

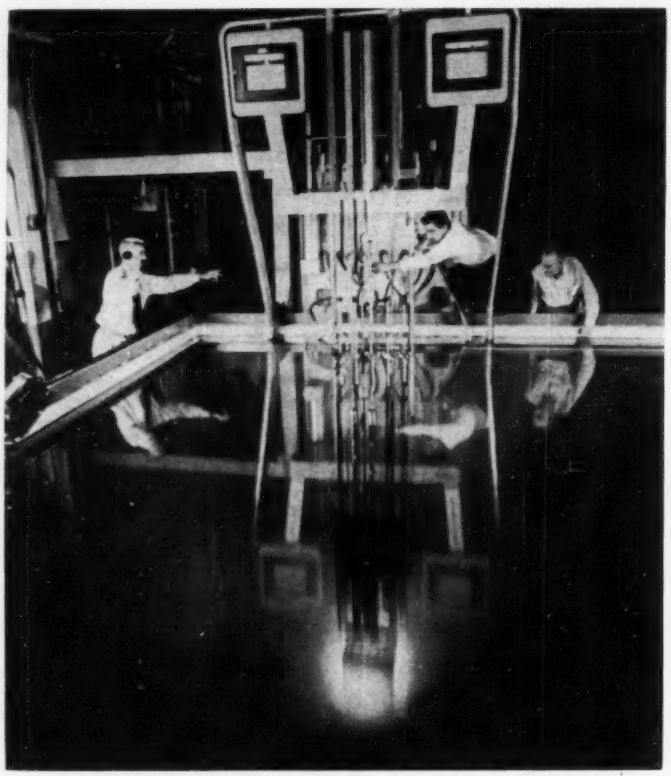
Representatives in principal cities

Mountain-Piped Oil To Turn Turbines

Crude oil rushing through the 8- and 10-inch pipelines that run down the steep sides of the Andes may soon be used to turn turbines generating electricity.

The idea for the new energy source came to Williams Brothers, international-operating pipeline construction company, while trying to solve a pressure problem in a pipeline that drops 15,000 ft. within a 48-mile stretch, building pressure to 4,000 psi. at its terminal point in the port city of Arica, Chile. Instead of using pressure-reducing stations, the excess energy can, the company believes, be channeled to serve the electrical requirements of that city of 30,000.

It's expected that 75-kw. generators will be powered by the flowing crude oil. Traffic through the pipeline is expected to reach 25,000 bbl. a day by 1956. This is the minimum amount needed to turn the turbines.



U. S. Atomic Reactor—On View for the World

For the first time the public has been able to see an operating atomic reactor (above). It was built by Union Carbide at Oak Ridge for $350,000 and exhibited at the Geneva conference on peaceful uses of atomic energy in August. Protected by 16 ft. of water which acts as a radiation shield, a coolant and a moderator, technically qualified visitors could actually operate the swimming-pool reactor. Anyone could watch it operate.

Not primarily a power source, the Geneva reactor is designed for research—radioisotope production, irradiation studies, neutron activation analysis, fuel regeneration. It has been sold to the Swiss government for well below its original cost.

Ground Broken for Huge Uranium Mill

The biggest U. S. uranium mill, an $8 million plant near Moab, Utah, is now being built for Uranium Reduction Co. Designed to use the AEC's resin-in-pulp process, it will be ready for use sometime next summer. National Lead Co. and American Cyanamid Co. helped research the process.

Ore—up to 1,000 tons a day—will come from the famous Mi Vida mine discovered by Charles Steen.

News Briefs

Sulfuric acid: Reichhold Chemicals next March will start making sulfuric acid for the first time—at an $800,000, 100-ton/day unit at Tuscaloosa, Ala.

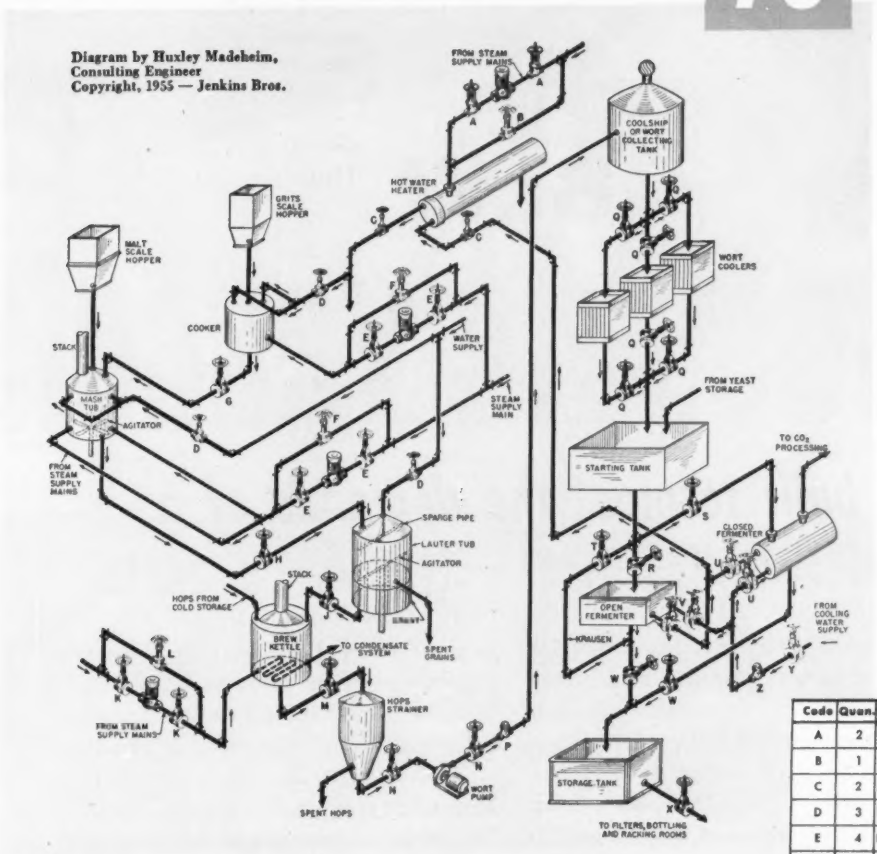
Ethylene: Dow Chemical of Canada plans a $3 million expansion to boost its ethylene capacity by 70%. It will be completed in mid-1956.

Titanium: Columbia-Southern Chemical Corp. and Imperial Chemical Industries want to build a $10 million plant at Natrium, W. Va., to make granular—not sponge—titanium. They've asked for a contract under which the government would buy 5,000 tons/yr.

Methanol: Heyden Chemical's and Monsanto Chemical's jointly owned methanol plant at Texas City, Tex., will be operating this fall.

Nylon: Chemstrand Corp.'s nylon plant at Pensacola, Fla. is going to be expanded to 88 million lb./yr. Started up in 1953 with a capacity of 50 million lb., a first expansion was authorized last December to 58 million lb.

JENKINS PRACTICAL PIPING LAYOUTS 76



How to plan piping connections for a GRAVITY-FEED MULTIPLE-STORY BREWERY

This piping layout is typical of installations in many breweries designed for gravity-feed processing, and the principal operations are briefly outlined.

Corn grits are cooked with water in the cooker, with enough added malt to convert and liquefy the grits. When the malt, which has been mixed with water in the mash tub, is properly steeped, the finished cook is dropped into it and the resulting mash thoroughly mixed.

Pumped into the Lauter tub, the mash grains settle to form a filter bed, from the bottom of which the clear liquid containing fermentable and unfermentable sugars is drawn. Extraction is increased by "sparging" with hot-water spray. This liquid, the "wort", flows by gravity to the brew kettle.

In the brew kettle, the wort is boiled with hops to add flavor and to clarify and preserve it. The hops are then strained off, and the liquid is pumped to the "coolship" tank to settle. It then goes through coolers to reclaim most of the residual heat, and on to the starting tank.

In the starting tank, the yeast is added, and the mixture flows to the fermenters, some of which are closed to collect the carbon dioxide gas for future use. After fermentation, the beer is cooled again and sent to storage tanks for eventual bottling and racking.

Consultation with accredited piping engineers and contractors, experienced in brewery design, is recommended when planning any phase of the various processing systems.

To simplify planning, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information.

VALVE RECOMMENDATIONS
For details of valves to suit varying conditions see Jenkins Catalog.

Code	Quan.	Jenkins Valve	Service
A	2	Fig. 275 Bronze Gate	Shutoff steam to heater
B	1	Fig. 556-P Bronze Globe	Bypass to heater
C	2	Fig. 47 Bronze Gate	Shutoff water heater
D	3	Fig. 106-A Bronze Globe	Continuous water flow
E	4	Fig. 204 I.B. Gate	Process steam shutoff
F	2	Fig. 576-P Bronze Globe	Bypass water valve
G	1	Fig. 677-A Bronze Gate	Shutoff cooker mash
H	1	Fig. 677-A Bronze Gate	Shutoff finished mash
J	1	Fig. 677-A Bronze Gate	Shutoff wort to kettle
K	2	Fig. 204 I.B. Gate	Shutoff steam to kettle
L	1	Fig. 576-P Bronze Globe	Bypass to kettle
M	1	Fig. 677-A Bronze Gate	Shutoff wort line
N	2	Fig. 677-A Bronze Gate	Pump shutoff
P	1	Fig. 352 Bronze Swing Check	Prevent backflow
Q	6	Fig. 677-A Bronze Gate	Shutoff coolers
R	1	Fig. 677-A Bronze Gate	Shutoff open fermenter
S	1	Fig. 677-A Bronze Gate	Shutoff closed fermenter
T	2	Fig. 677-A Bronze Gate	Krausen line
U	2	Fig. 675-A Bronze Gate	Water to closed fermenter
V	2	Fig. 675-A Bronze Gate	Water to open fermenter
W	2	Fig. 677-A Bronze Gate	Shutoff storage
X	1	Fig. 677-A Bronze Gate	Shutoff rack & bottling
Y	1	Fig. 675-A Bronze Gate	Shutoff well water
Z	1	Fig. 352 Bronze Swing Check	Prevent backflow

JENKINS VALVES
LOOK FOR THE JENKINS DIAMOND
SINCE 1864
JENKINS BROS.

SOLD THROUGH PLUMBING-HEATING AND INDUSTRIAL DISTRIBUTORS

B&W
pressure vessels
built to meet the demands of a SPECIAL JOB—OR ANY JOB

To expand its facilities for producing the higher octane gasolines required by so many modern automobiles, a leading oil company selected B&W to build three large reactors for one of its refineries.

Each vessel is 5 ft. I.D. by 30 ft. long, has a shell thickness of 2 5/16 in. The material of the main shell meets ASTM specification A-301—a 1 per cent chromium steel with molybdenum.

The internals and bottom head linings are of 13 per cent chrome alloy. These alloy steels were used to meet operating requirements involving temperatures of about 950 F.

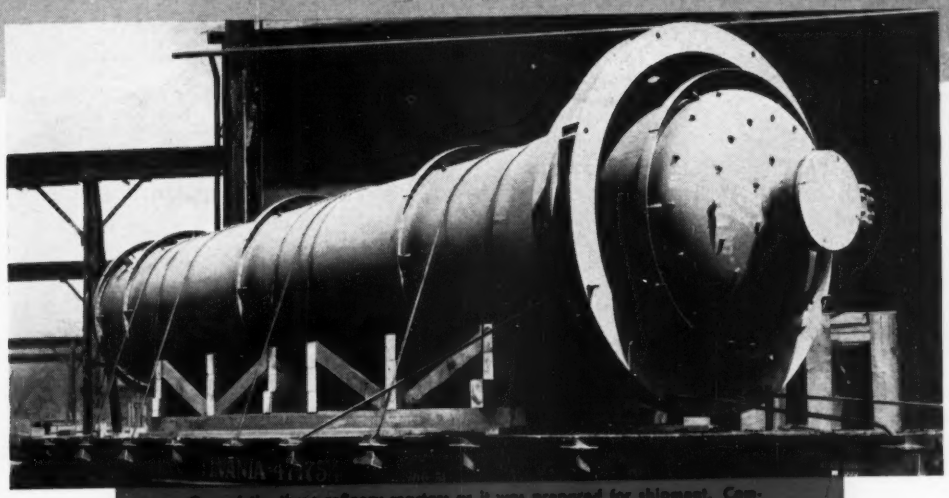
To assure the ultimate in safe and sound process equipment, the same uncompromising care and the most advanced techniques go into the fabrication of every B&W Pressure Vessel, regardless of its ultimate application. Forming, machining, welding, stress-relieving, x-raying,—every production operation from start to finish—is performed on equipment designed specially for the job. And much of the equipment and types of construction used are original B&W developments.

Because of this close attention to design and fabrication details, B&W Pressure Vessels have long enjoyed a reputation for high quality. If your operations require the use of pressure vessels of any type, with working pressures up to 6000 psi, your inquiry will receive careful attention. The Babcock & Wilcox Company, Process Equipment Dept., Barberton, Ohio.

BABCOCK & WILCOX

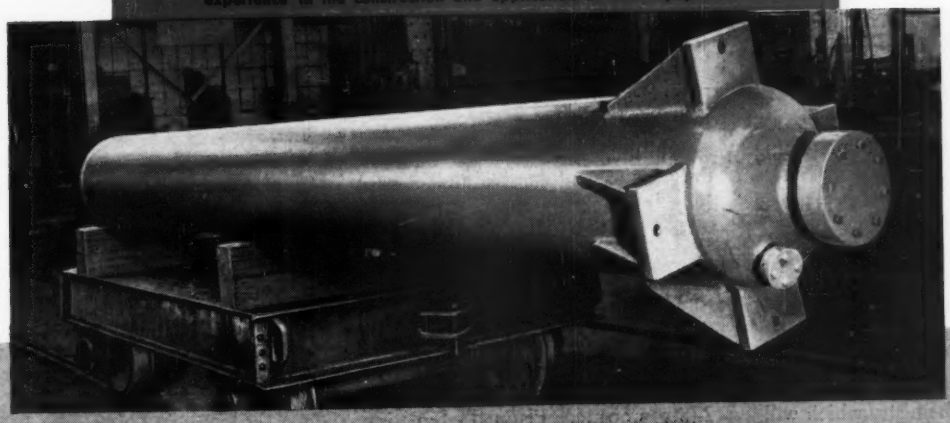
BOILER DIVISION

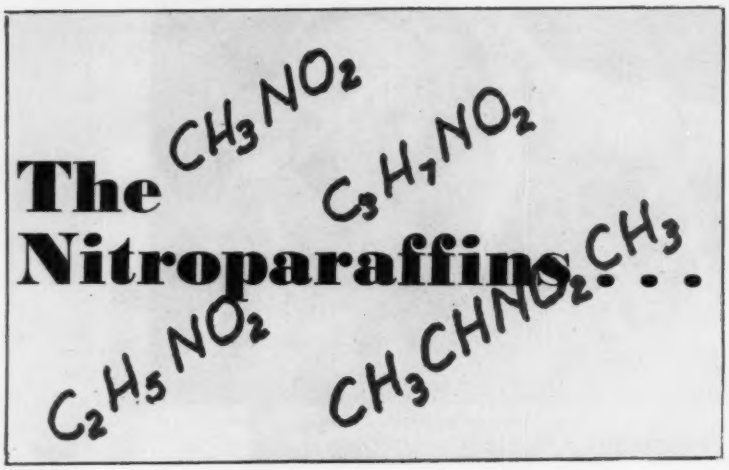
S-435



One of the three refinery reactors as it was prepared for shipment. Completion of these special pressure vessels in the comparatively short time required was accomplished by exceptional coordination between the engineering, testing, and fabrication divisions at B&W's Barberton plant.

B&W Pressure Vessels of all types are designed for various jobs with working pressures to 6000 psi. B&W engineers draw on a wealth of experience in the construction and application of such equipment.





Solvents and Stepping Stones

Precocious chemicals reach maturity as the first big nitroparaffin plant goes on stream. Behind it: 20 years of hard work. Ahead: 10 million lb. in 1956.

It's taken Commercial Solvents Corp. a score of years to put the nitro group in paraffins and make it stick. It's taken plenty of imaginative research and engineering to put the tower-studded nitroparaffin plant at Sterlington, La., on stream this year.

Equally important to CSC's program, though, has been an extraordinary amount of market appraisal and development work, of sales surveying, of projecting probable demand at various price levels, of working out a practical sales pattern. These tasks, difficult at best, are even more complex when introducing a whole group of previously unavailable chemicals like the nitroparaffins and their derivatives.

Whether nitroparaffins present a new field of chemistry which will, as CSC believes, rival that of coal tar derivatives remains to be seen. Certainly all concerned at Commercial Solvents have brought these chemicals–which are unusually good solvents and promising raw materials for chemical synthesis– to the point where the impact, today, of their commercial availability is very real. CSC's recent and sizable pilot plant capacity of two million pounds a year has been supplying nitroparaffins to agriculture, petroleum, textile, drug, paint, automotive and other industries for some time now.

▶ **Backing It Up**—Follow-through after impact is the job of the new plant at Sterlington. It has a capacity–with provision for expansion– of ten million pounds a year of the four nitroparaffins, nitromethane, nitroethane, 1-nitropropane and 2-nitropropane. Planned, too, is production of such nitroparaffin derivatives as nitrohydroxy and aminohydroxy compounds, and hydroxylammonium salts.

▶ **Useful in Themselves**–As a class, the nitroparaffins are powerful, selective solvents for many coating materials, waxes, resins, gums, dyes and organic chemicals. They are priced in the 20-25¢ a lb.-range.

• Nitromethane, perhaps the most interesting nitroparaffin, is a solvent for vinyl resins, nitrocellulose, cellulose acetate, cellulose acetate butyrate, acrylonitrile polymers and polystyrene.

• Nitroethane, a useful solvent for vinyls and cellulose esters, is an attractive raw material for pharmaceutical synthesis.

• 1-Nitropropane has solvent properties similar to nitroethane and is used by CSC as a raw material for manufacture of hydroxylammonium salts.

• 2-Nitropropane dissolves vinyls and cellulose esters, is starting point for 2-amino-2-methyl-1-propanol.

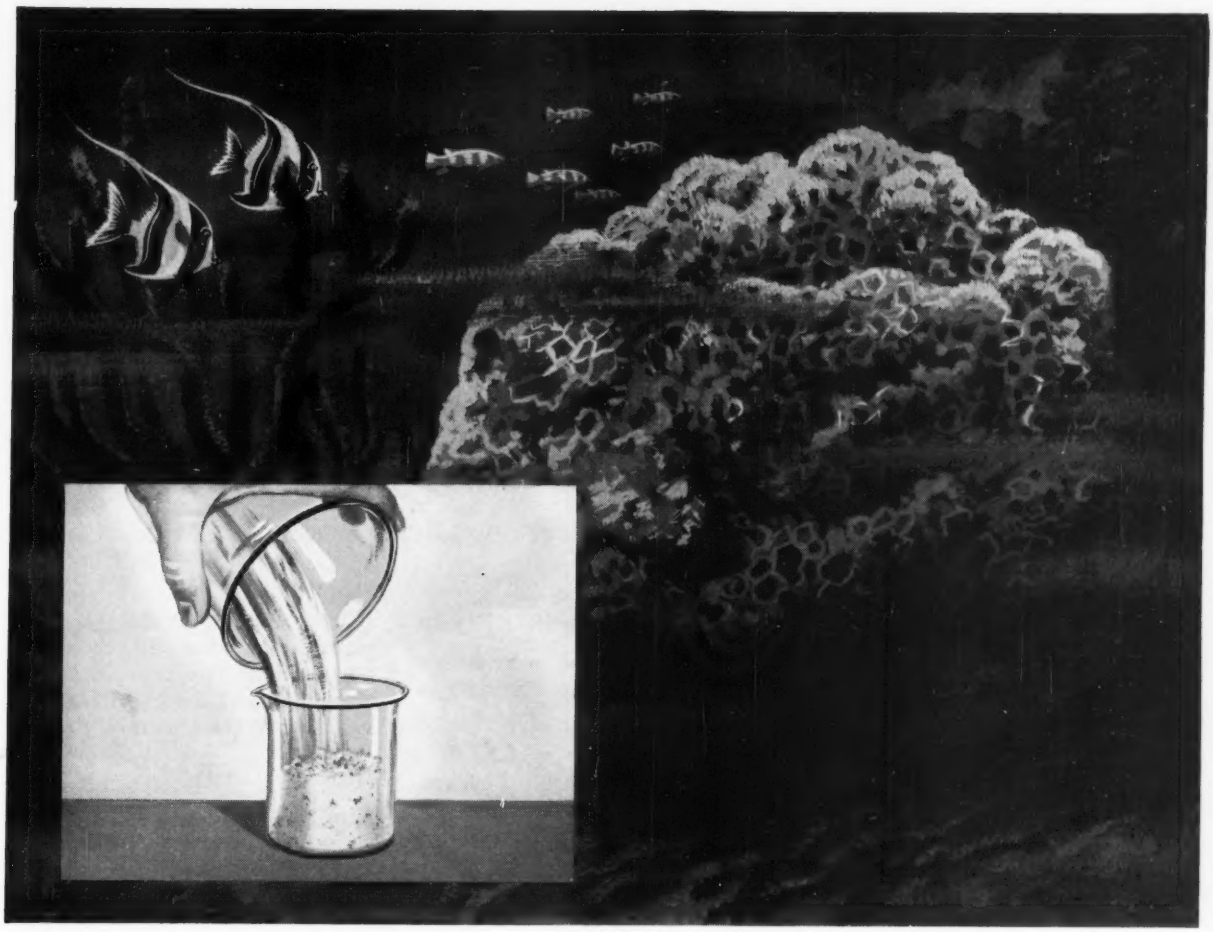
Condensation of aldehydes with primary and secondary nitroparaffins yields either nitroalcohols or nitroolefins, depending on conditions. Acid reduction of the nitroalcohols yields aminoalcohols. Reduction of primary isomers with alkali and metals yields amines.

▶ **Derivatives**–Already more than 2,000 derivatives have been isolated in Commercial Solvents' labs. Many more are possible and will be sought. For the time being, the Sterlington plant expects to make the following:

2-Amino-2-methyl-1-propanol –an emulsifying agent (in the form of its soaps) for floor wax and emulsion paints, and a stabilizer in melamine enamels. Price: 40-45¢ a lb.

Tris (hydroxymethyl) aminomethane–for synthesis of surface active agents, resins, textile specialties and drying oils. Price: about 50¢ a lb.

2-Amino-2-methyl-1, 3-propanediol–for synthesis of surface active agents; an ingredient of textile specialties. Price: about 75¢.



Like nature's porous sponge, Celite has extremely high absorptive capacity. It absorbs 220% of its own weight of water (Gardner-Coleman method)

High absorption

Celite diatomite powders absorb twice their own weight of liquid

Here is a material in powder form, so porous that 93% of its volume consists of tiny interconnected pores. This unique structure gives Celite* an exceptionally high absorptive capacity which is now being put to profitable use in a wide variety of industries. For example, Celite serves as a dry carrier for insecticide poisons . . . helps control viscosity in adhesives . . . and makes a highly effective anti-caking agent in fertilizers.

The unique structure of the microscopic Celite particles offers many other advantages. These particles are spiny and irregularly shaped, strong and rigid . . . as a result they do not pack together. Thus Celite powders have great bulk per unit weight . . . making them valuable for fluffing up dry powders such as household cleansers . . . and extending pigments in paint and paper.

Celite's physical structure itself is also utilized in many different ways . . . as the outstanding flatting agent for paints . . . as a mild non-scratching abrasive for fine polishes . . . and to improve surface appearance in plastics. And it is also the reason why Celite can add strength, toughness, stiffness, durability and many other desirable characteristics to your product.

If you want improved product performance or lower production costs, investigate industry's most versatile mineral filler. One of the J-M Celite Engineers will gladly discuss your problem. These men are backed by complete technical services and the Johns-Manville Research Center, largest laboratory of its kind in the world.

For further information write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ont.

*Celite is Johns-Manville's registered Trade Mark for its diatomaceous silica products.

JOHNS-MANVILLE JM PRODUCTS **Johns-Manville CELITE** INDUSTRY'S MOST VERSATILE MINERAL FILLER

Newsworthy chemicals this month

Nitroparaffins—rich new field.....142A
Isophthalic acid alkyds.....144A
Liquid polybutadiene.....144B
Flocculating agent.....146A
Glass cladding for buildings.....146B
Synthetic polysaccharides.....146C
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Fluorochemical paper sizing.....150A
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Three new plasticizers.....150E
Liquid chlorinated paraffin.....150F
Thiophene.....150G
Aluminum yarn.....150H
Nitrile latices.....150I

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Hydroxlammonium acid sulfate—effective controlled reducing agent; raw material for synthesis of oximes (oxidation inhibitors and vulcanization accelerators). Price: about 27¢ a lb.

Hydroxylammonium sulfate—higher purity, neutral counterpart to the acid sulfate. Useful as a controlled reducing agent for metal ions in acrylic fiber dyeing. Price: about 75¢ a lb.

Alkaterge-C — oil-soluble surface active agent, emulsion stabilizer and acid acceptor (for lube oil use); a pigment grinding aid; dispersing agent for solids in organic liquids; and an anti-foam agent. Price: about 58¢ a lb.

▶ **What's Next**—Next derivatives to be offered commercially will probably be 2-amino-1-butanol and 2-amino-2-ethyl—1, 3—propanediol. Previously unavailable before, these compounds are raw materials for the synthesis of surface active agents.

Latest compounds available in experimental volume are three diamines: 1-isopropyl-2-methyl-1 2-propanediamine; 1-phenyl-2-methyl-1, 2-propanediamine; and 1-(1,1-dimethyl-2-hydroxethyl)-2-methyl-1,2-propanediamine. Suggested applications include use as curing agents for epoxy resins, as alkaline catalysts, as stabilizers for melamines and other resin finishes, as dye intermediates, and in the manufacture of pharmaceuticals and surface active agents. **142A**

Isophthalic Acid Alkyds

For faster drying, more flexible films with better exterior durability.

Confidence that isophthalic acid alkyds offer substantial surface-coating advantages over conventional phthalic anhydride resins has prompted their semi-scale manufacture prior to commercial availability of the raw material acid expected later this year.

Premium properties of the new alkyds: faster drying at equal oil lengths, less tendency for "skin-drying," improved exterior durability, and more flexible films. Three of the new alkyds have been made available in sample quantities.

A very long oil alkyd, called SF-2535 Super Beckosol, has been particularly designed for exterior house paints, printing inks and other applications requiring a low viscosity, high solid resin with good brushing characteristics.

Another long oil alkyd, SF-1528, is said to offer the excellent color retention and outstanding durability needed for architectural white enamels, exterior structural steel paints, enamel undercoaters and industrial primers.

A short oil alkyd for use in primary automotive finishes of the baking type shows rapid curing properties by itself or with very low driers of amine content. Called PX-374 Super Beckosol, it is unusual because, in addition to isophthalic acid, other relatively new raw materials have been used in its manufacture.—**Reichhold Chemicals, Inc., White Plains, N. Y.** **144A**

Liquid Polybutadiene

Cross-linking properties foretell use in coatings, casting and laminating resins.

Unusual structure of liquid polybutadiene, a highly unsaturated new polymer sprinkled with cyclo-olefinic rings, is thought to account for its exceptional reactivity and high aptitude for use in casting and laminating resins, protective coatings and as a vulcanizable rubber softener.

Heating liquid polybutadiene to 500°F. in the absence of air forms a highly cross-linked, transparent resin which shows little or no deterioration at temperatures as high as 600°F. The resins adhere well to glass and can be used as a binder for the preparation of fiber glass reinforced laminated. Maleic anhydride reacts with polybutadiene to form a highly cross-linked polymer which offers possibilities as an ion exchange resin.

A protective coating with a high gloss and a strong, hard finish can be produced from liquid polybutadiene by adding a common metallic drier and a mineral solvent. Polybutadiene's freedom from odor

MAKE NEW AND
BETTER PRODUCTS...
with

DIETHYLENE TRIAMINE

$H_2NCH_2CH_2NHCH_2CH_2NH_2$

* **SYNTHETIC RUBBER . . .**

a catalyst activator in "cold" polymerization of synthetic rubber . . . a "short" stopper in general synthetic rubber polymerization . . . an accelerator in the vulcanization of foam rubber.

* **SURFACE COATINGS . . .**

an anti-livering agent in varnishes . . . catalyst for epoxide resins . . . solvent for many resins and dyes.

* **TEXTILE SPECIALTIES . . .**

in the preparation of textile-treating and finishing agents . . . solvent for many dyes.

* **METAL AND METAL WORKING . . .**

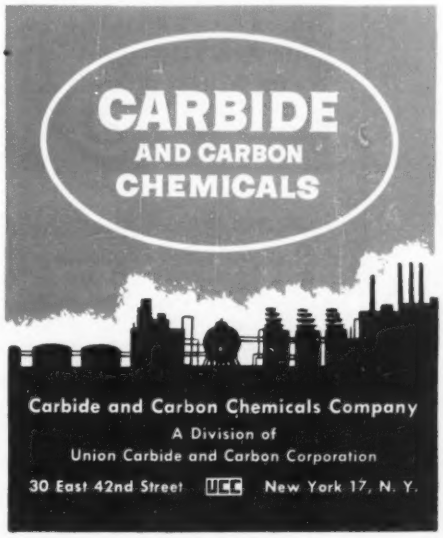
to make flotation agents and emulsion breakers . . . for use in bright copper plating.

* **OTHER USES . . .**

to make emulsifiers . . . wetting agents . . . emulsion breakers . . . ion exchange and other resins . . . asphalt additives . . . insecticides . . . fungicides.

For Additional Information—

. . . on diethylene triamine and other ethylene amines, call the nearest CARBIDE office and ask for F-8163. CARBIDE also manufactures about 75 other aliphatic nitrogen compounds. For information on these products, ask for the booklet, F-4770. Offices are located in 23 principal cities. In Canada: Carbide Chemicals Sales Company, Division of Union Carbide Canada Limited, Toronto.



and taste and its chemical resistance point toward use in food can enamels.

Used as a softener for natural or synthetic rubber, it covulcanizes with the rubber and is only partially extractable from the stock after vulcanization.

Like the rubberlike products of diene polymerization, the liquid polymer is made by sodium catalysis. However, the reaction takes place in a solvent at elevated temperatures with an increased charge of catalyst.—**Phillips Petroleum Co., Bartlesville, Okla.** 144B

Flocculating Agent

Small quantities improve sedimentation and filtration in disposal and recovery operations.

A new synthetic resin called Good-rite K-720 collects small liquid-dispersed particles into larger clusters to improve the degree and rate of sedimention. In filtration, flocculation with K-720 is said to form a more porous filter cake with resultant reduced pressure drop and increased throughput. Efficient washing of the filter cake is more easily accomplished.

Treatment is low cost because as little as 0.01 lb. of K-720 per ton of dispersed solids normally is sufficient.

It promises to aid in solving pollution and recovery problems in the paper, textile and mining industries and in the area of sewage disposal.

The resin is also available as a 20% water solution identified as Good-rite K-720S.—**B. F. Goodrich Chemical Co., Cleveland, Ohio.** 146A

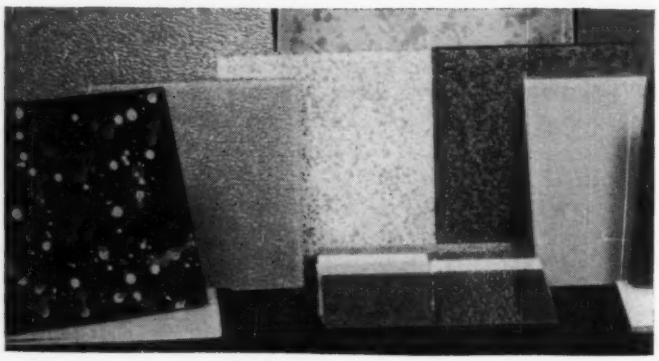
Synthetic Polysaccharides

Solutions are characterized by excellent stability, clarity, and compatibility.

Cold-water dispersible synthetic polysaccharides are now available in four viscosity grades. Called Polyose A, B, C and D, they all have properties similar to vegetable gums of the arabic type, high soluble dextrines and similar water soluble adhesives.

Polyose A is suggested for applications requiring the use of water-soluble adhesives having good flow and freedom from setback at high solids. Polyose B gives higher viscosity and better adhesion than Polyose A. Polyose C is more viscous than Polyose B and may be preferred for replacement of gum arabic in adhesive applications. Polyose D does not have the length and initial tack possessed of the others but its final adhesion is excellent.

By proper selection or blending, the four Polyoses may find use as: adhesive ingredients in compositions for special paper laminating and straight-line gluing and in remoistening gum and mucilage formulations; functional extenders for more expensive water-soluble gums such as polyvinyl alcohol; replacements for tapioca dextrine and gum arabic in prepared pastes and for pigment suspension and binding applications; agents for upgrading compositions bases on less stable dextrines and starches.—**Corn Products Refining Co., New York 4, N. Y.** 146C



Forerunner to Jewel-Like Cities?

New heat-strengthened glass panels like those above have already proved tough enough to warrant their use in cladding several recently completed buildings. Process for fusing ceramic color to a plate glass base gives the panels, called Spandrelite, far greater shock resistance than ordinary plate glass of the same thickness. Color side is mounted down providing the additional weather protection of ¼ in. or more of glass—glass which is nonporous, self-cleaning, non-absorbent, stain and odor proof and which affords a wide choice of jewel-like visual effects.—Pittsburgh Plate Glass Co., Pittsburgh 22, Pa. 146B

Plastic Over Plywood

Overlay of wood fiber fused with phenolic resin grooms plywood for outside construction.

Look for a surge in plywood use outside if Crezon, a tough, paintable plastic overlay, is as good as it looks.

Plywood has been pretty much limited to interior use because it couldn't stand up to severe weather conditions. However, accelerated weather tests—moisture, heat, cold and fungus growth—show that Crezon-treated plywood will not check (if painted) under extreme conditions.

Made from tough phenolic resin and wood fiber, Crezon is bonded inseparably to plywood by heat and pressure at the mill. The coating itself can be worked easily before

Introducing

3 NEW ALKATERGES

compare these new versatile

SURFACE-ACTIVE AGENTS

Compare the physical properties of these new additions to the CSC family.

Physical Properties	Alkaterge C	Alkaterge A	Alkaterge E	Alkaterge T
Color, Gardner (1933)	15	7	7	7
Solidification Point, °C	−40	−41	−50	59
Specific Gravity @ 20/20°C	—	0.885	0.926	—
Specific Gravity @ 25/25°C	0.925	0.883	0.924	—
Wt. per US Gallon @ 68°F, lbs.	7.71	7.37	7.72	—
Coefficient of Expansion, per 1°F	0.00067	0.00061	0.0043	—
Refractive Index, n_D @ 25°C	—	1.4631	1.4738	—
Viscosity:				
Saybolt Universal @ 100°F. sec.	—	79.9	299	—
Centistokes @ 100°F.	71*	14.5	62	—
Interfacial Tension Against Water, dynes/cm:				
0.1% solution in mineral oil	2	24.6	18.1	1.8
1% in m.o. against sat. ag. sol'n.	—	10.5	3.7	—
Surface Tension, sat. ag. sol'n. dynes/cm:	42	37.6	37.8	30.4
Flash Point, Cleveland Open Cup, °F.	400	325	395	None
Solubility, ml/100 ml:				
In Water	0.005	0.005	0.4	0.01
Water in product	—	3.8	2.56	—

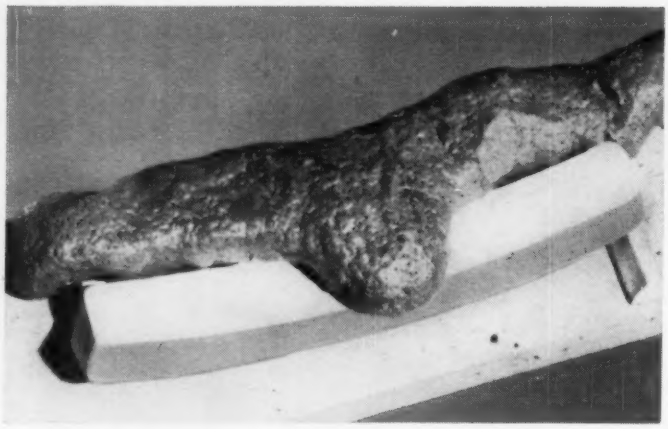
*at 96°F

Now, Commercial Solvents offers three new surface-active agents that are closely related to ALKATERGE-C. Because of the latter's proven industrial usefulness, demand exceeds supply. Production facilities are being expanded. Many of CSC's customers have found that ALKATERGE-A, -E, or -T do equally well or better in many of the jobs formerly accomplished by ALKATERGE-C. While they differ somewhat in individual properties, they should prove useful as auxiliary emulsification agents, antifoam agents, dispersing agents, spreading agents, pigment-grinding assistants, acid acceptors and in numerous other applications. Test all or any of these three new alkaterges for yourself. For complete information and a sample, write to Market Development Department, CSC, 260 Madison Ave., N.Y. 16, N.Y.

COMMERCIAL SOLVENTS

260 MADISON AVENUE **CORPORATION** NEW YORK 16, N. Y.

CSC INDUSTRIAL CHEMICALS



Synthetic Mica: Key to Usefulness at 1,000 F.

Synthetic mica, pulverized and bonded with high-grade electrical glass, has been given credit for the high temperature resistance of a new electrical insulation material. Called Supramica ceramoplastic, it withstands 1,000°F. compared with 700°F. for similar compounds made with natural mica.

Picture shows how Supramica insulation (bottom) resisted deformation at 1,100°F. Bar containing natural mica swelled and foamed.

Expected to find wide use as an insulator for electronic components in high speed aircraft and missiles where extreme temperatures are often encountered, the new material is also of value for nuclear work because it resists the effects of radiation as well as high temperature. The product also provides total and permanent dimensional stability, low electrical loss, and excellent arc resistance. It is impervious to water, oil, and organic solvents.–Mycalex Corp. of America, Clifton, N. J. 148A

application: planed, sawed, shaped, etc. Grain size is eliminated–paint will go on easier and last longer than it will on ordinary plywood.–**Crown Zellerbach Corp., North Portland, Ore. 146D**

Kojic Acid

Pyrone has four reactive groups in the benzene ring.

Industrial fermentation is bringing a 50-year-old research chemical, kojic acid, into the commercial spotlight. Here's a rundown of this intermediate's multifunctional repertoire:

• Dyes prepared from this compound for cotton, silk and wool show fastness to washing and light.

• Kojic acid's good ultraviolet absorption curve may fit it for cosmetic sunscreen preparations.

• Stable metal chelates can be formed at the four and five positions of kojic's ring.

In addition to a pyrone oxygen, kojic acid has carbonyl, hydroxyl and benzyl alcohol groupings. It can be used to make resins, aldehyde condensation products, Mannich bases, pyridones and pyridines. –**Chas. Pfizer & Co., Inc., Brooklyn 6, N. Y. 148B**

Polyacrylate Solution

Dispersant–binder deposits flexible, water resistant, durable film.

On the counts of particle suspending properties, film flexibility and water resistance upon drying, a new water solution of a modified polyacrylate is said to surpass casein, the substituted celluloses or ordinary polyacrylate solutions as a dispersant and binding material.

Called Hycryl A-1000, it is said to reduce or eliminate the need for protein stabilizers in formulating pigment dispersions and to deposit a dried film which will not discolor, is not affected by sunlight or normal ageing conditions.

The material has been recommended for the preparation of aqueous dispersions of pigments or other finely divided substances where maximum solids concentration at minimum stable viscosity is required and where water resistance of deposited particles, minimum settling and simplicity of formulation are desirable. It is expected to find use in tannery finishes, rubber latex compounding, pigment-dyeing formulations and the preparation of coatings for specialty papers.–**Union Bay State Chemical Co., Cambridge, Mass. 148C**

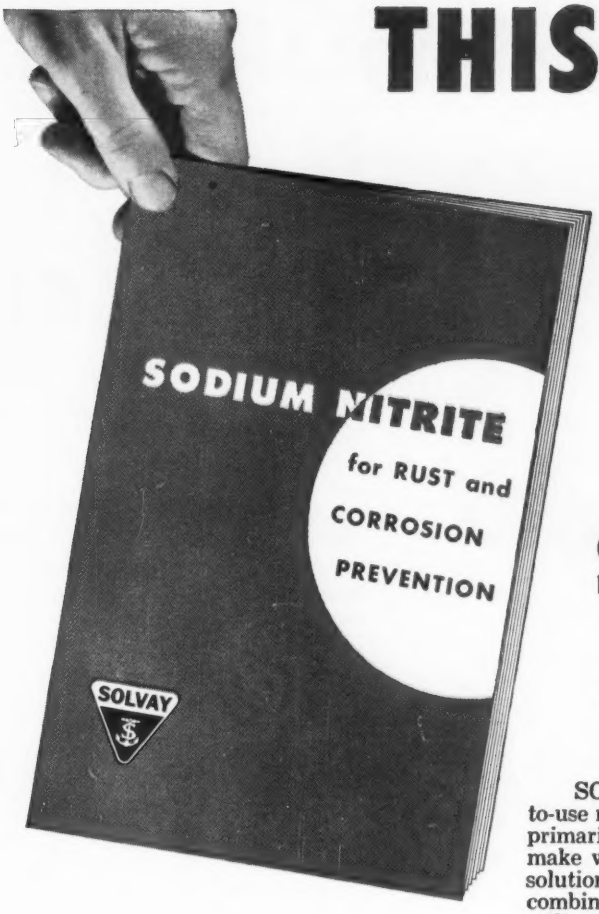
Surfactants

For efficient emulsifying systems produced under corrosive, high temperature conditions.

A new series of perhalogenated, monobasic carboxyl acids derived from chlorotrifluoroethylene are characterized by high thermal stability, up to 450 F.; resistance to strong acids and oxidants; selective reactivity of a carboxylic acid; surface activity in highly acidic, basic or oxidizing media; low vapor pressure; and high density.

Uses indicated by these properties include: promotors for two-phase reactions; additives for metal treating baths; insecticidal dispersants; rubber accelerators, anti-oxidants and stabilizers; and chemical intermediates.

Called Kel-F Acids, they undergo reactions involving the carboxyl group. They are readily miscible in all proportions with most organic liquids. –**M. W. Kellogg Co., Jersey City, N. J. 148D**



THIS NEW BOOK

Tells How To

CONTROL or PREVENT RUST and CORROSION with SOLVAY SODIUM NITRITE

and

Sodium Nitrite Mixtures

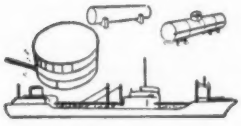
SOLVAY Sodium Nitrite provides a low-cost, safe and easy-to-use means of protecting many metals from rust and corrosion, primarily iron and steel. Dilutions as low as 1/10th of 1% will make water solutions non-corrosive; and 3 to 5% spray or dip solutions will produce protective films on metal surfaces. When combined with materials such as phosphates or caustic soda, sodium nitrite's protective action can be extended or obtained during cleaning, neutralizing or similar operations.

This new booklet contains detailed information on how SOLVAY Sodium Nitrite prevents rust and corrosion, and how its protective action can be utilized, either alone or in combination with other materials. It also contains an extensive bibliography covering 59 published papers on the use of sodium nitrite and nitrite compounds for corrosion prevention.

For your free copy, fill out and mail the coupon today. There is no cost or obligation.*

*In Western Hemisphere Countries.

A Few Typical Applications



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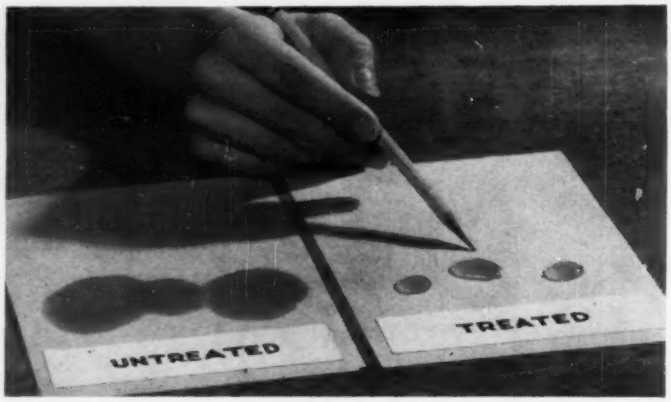
Ortho-dichlorobenzene • Chlorine • Methylene Chloride • Methyl Chloride • Carbon Tetrachloride



Paper's New Fluorochemical Coat Sheds Oil

A new fluorochemical paper-sizing agent will coat every fiber with an oil-resistant film without affecting strength, porosity, flexibility, appearance or color of the paper. Widespread use is expected on kraft papers destined for heavy-duty wrapping of oily gears, bearings, pistons and oily materials like putty and calking compound. In addition, it works well on fiber drums, paperboard containers and it prevents "bleedback" in laminated and coating paper constructions. Treatment can be effected with existing equipment in most paper production lines by spraying or pressing the agent on the moving paper.–Minnesota Mining and Manufacturing Co., St. Paul, Minn. 150A

Briefs

Phenanthrene, fluoranthene and pyrene which contain no troublesome impurities have been made available. For example, phenanthrene contains none of the carbazole which usually contaminates it. Used mainly in the preparation of dyestuffs and pharmaceuticals, all three–made via coal hydrogenation–are expected to be available in commercial quantities by the end of the year.–**Union Carbide and Carbon Corp., New York 17, N. Y. 150B**

Surface-conditioned sulfurs, said to have superior free flowing and blending characteristics, are now being offered commercially in standard grades. They also reduce dusting and attendant hazards from static-induced fires during rubber compounding and are particularly recommended for the compounding of polymers that are difficult to reduce in size and disperse.–**Stauffer Chemical Co., New York 17, N. Y. 150C**

Domestic vinyl chloride resins price has been cut from 38¢ to 31¢ per lb. to encourage the market expansion necessary to accommodate new industry capacity and to compete with the 32¢ price of the imported product. The cut is for vinyl chloride-vinyl acetate copolymer. Solvent resin types were reduced one to three cents and emulsion resins six to seven cents a pound.–**Union Carbide & Carbon Corp., New York, N. Y. 150D**

Three new plasticizers which impart good flexibility at reduced temperatures and are very low in volatility at elevated temperatures have been developed. They are a normal phthalate-ester of the semipolymeric type, a mixed alkyl adipate and an alkyl adipate ester complex, and are called, respectively, NL-F22, NL-F32 and NL-F33. Applications are expected in furniture upholstery, film and sheeting for rain coats and flooring compounds.–**National Lead Co., New York 6, N. Y. 150E**

A liquid chlorinated paraffin with 50% chlorine content is reported to provide superior color and heat stability. Called Chlorowax 50, it is odor-free, nontoxic and non-flammable and has a high viscosity of 125 poises.–**Diamond Alkali Co., Cleveland 14, Ohio. 150F**

Thiophene, a versatile heterocyclic sulfur compound, is available in large quantities now. It's similar in many respects to phenol, benzene and some unsaturated hydrocarbons. Thiophene readily nitrates, halogenates, alkylates, metalates, acylates, aminates and condenses with formaldehyde and maleic anhydride.–**Sharples Chemicals, Inc., Philadelphia 7, Pa. 150G**

Aluminum yarn may soon be in auto and truck tires. Already putting sparkle into dresses, automobile upholstery and draperies, this metal yarn can disperse heat from the high speed operation that strains materials in motor tires.–**Reynolds Metals Co., Louisville, Ky. 150H**

Nitrile latices, Chemigum Latex 236 and 246, are designed to upgrade the physical properties of paper, textile, leather and pigment products. Small particle size (average of 500 Angstroms –about one-fifth normal size), combined with high mechanical stability, gives greater coverage and closer contact with individual fibers.–**Goodyear Tire & Rubber Co., Inc., Akron 16, Ohio. 150I**

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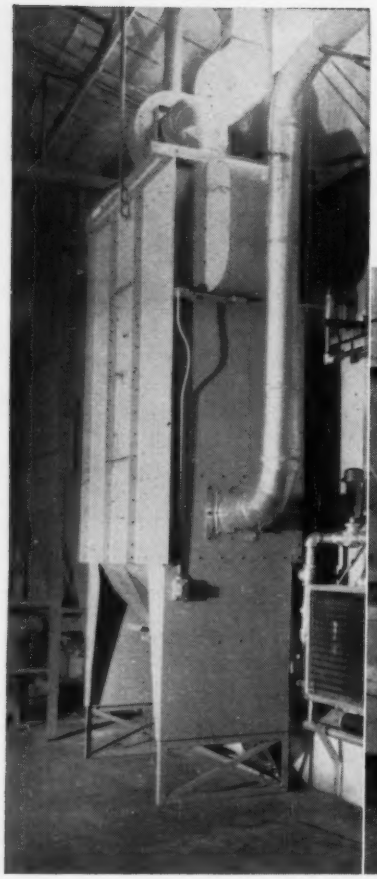
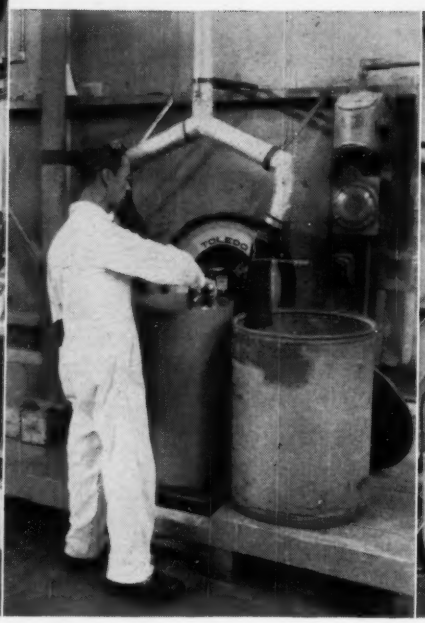
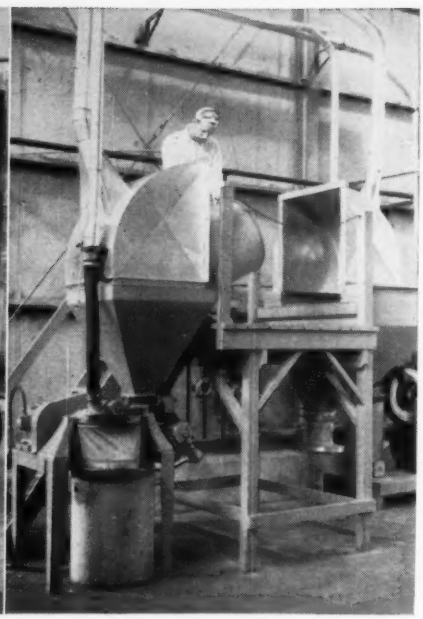


HOW NORWICH PHARMACAL CO.

STOPS PRODUCT LOSS





SALVAGES VALUABLE FURACIN WITH A WHEELABRATOR® DUSTUBE® COLLECTOR

Norwich Pharmacal Co. has added 2% to its gross output of furacin by installing a Wheelabrator Dustube Collector to ventilate two operations in its processing line.

Desiring to salvage as much of the product as possible, the company installed hoods over the milling and weighing stations and connected them to a highly-efficient Wheelabrator cloth tube type dust Collector. The Wheelabrator Dustube Collector filters the fine furacin powder from the air, removing more than 99% of this material. The high rate of recovery not only saves valuable material but it provides a more pleasant and comfortable place to work.

Norwich first learned of the efficiency of Wheelabrator Collectors in its aspirin tableting operations. Here a Wheelabrator Collector paid for itself by recovering 1% of the total material handled.

Besides direct financial gain, dust and fume removal pays off in better working conditions, and, in many instances, reduced wear and maintenance of machinery. Let the efficiency, simplicity and economy of Wheelabrator Dustube Collectors start paying off for you. Write today for additional information.

For more details, send now for your copy of Catalog 372.

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You can do a big favor for both your employees and your earnings statement by resolving to substitute Fuller conveying equipment for obsolete methods in handling dry pulverized or granular materials in bulk.

Your employees will be pleased with cleaner, safer, easier chores, and your stockholders will appreciate the savings your company can realize when Fuller conveying systems take over the job. And you will enjoy watching efficiency go up while costs come down.

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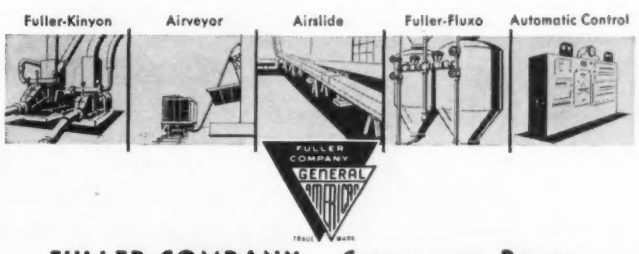
You're invited to visit Fuller at Booth 213 at the Chemical Show, Philadelphia, December 5-9



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Why let shell geometry present a production bottleneck on urgently needed heat exchangers, towers, and other pressure vessels? M. W. Kellogg's expanded and complete fabricating facilities are geared to produce shells thicker, bigger, and in shorter time than ever before.

Production tools recently installed at Kellogg's New Jersey shop to meet increasing demands for larger vessels include: a planer capable of handling steel plate 40 feet long; huge bending rolls, augmented by a new, ancillary 2,000-ton press for bending plate up to 4 inches thick; and automatic welding equipment for longitudinal seams to 16 feet in length, and circular seams 12 feet in diameter.

In heat treating, Kellogg now can handle vessels larger than a railroad car, with thirteen furnaces having temperature ranges from 1200 to 1950 deg. F. Its pipe bending facilities can shape carbon steel and alloy piping 36 inches in diameter—to exceptionally close tolerances. In nondestructive testing, Kellogg's latest addition is its Kel-Ray* Projector. Using gamma rays, this unique instrument permits the radiographic inspection of welded seams as thick as 6 inches in a single short exposure.

Backing up Kellogg's fabricating facilities are Kellogg engineers, who can either assume entire design responsibility or work closely with your own engineers; and Kellogg's staff of fabricating-welding engineers, who plan and administer a continuing personnel training program to qualify welders and mechanics on new techniques for fabricating new materials.

We welcome the opportunity to demonstrate what Kellogg's complete engineering and expanded fabricating service can do for *you*.

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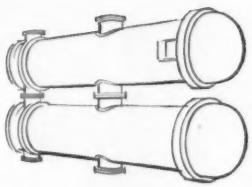
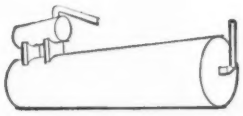
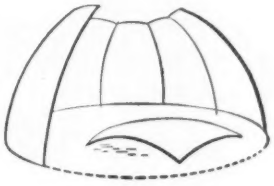


HEAT TRANSFER EQUIPMENT

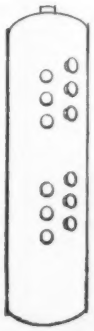


TANKS AND REACTORS



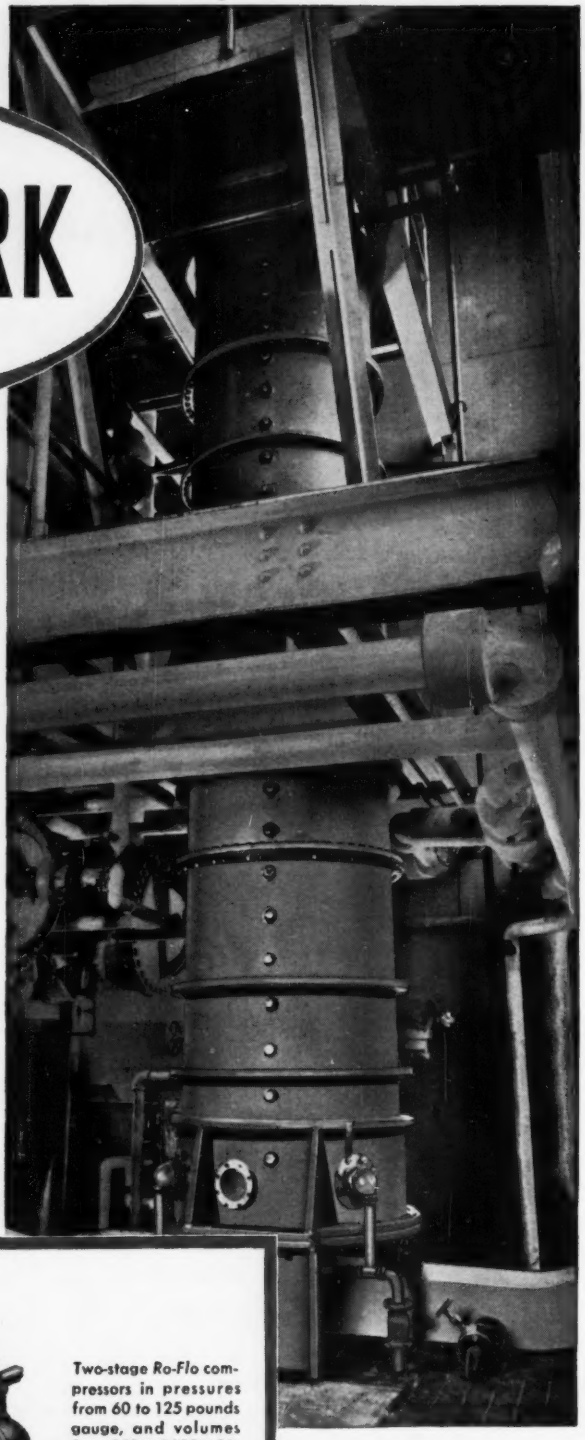
KNOCKDOWN VESSELS

PROCESS PIPING



PRESSURE VESSELS

AIR AT WORK



New two-stage Ro-Flo compressor provides constant efficiency... cuts maintenance

Efficiency and air supply are constant year after year with *Ro-Flo* compressors. Even if wear occurs, it automatically compensates for itself so that air supply is unaffected.

In addition, rotary design eliminates practically all vibration. No heavy foundations are needed.

Maintenance is cut too! There is no wear and tear from shock and vibration . . . no hard-to-maintain pistons and valves.

For constant efficiency . . . overall savings on air, modernize air supply with two-stage *Ro-Flo* compressors.

GET THE FACTS: Contact your A-C office or write Allis-Chalmers, Milwaukee 1, Wis.

Ro-Flo is an Allis-Chalmers trademark.

Two-stage *Ro-Flo* compressors in pressures from 60 to 125 pounds gauge, and volumes from 250 to 1800 cubic feet per minute. Single-stage units for lower pressures.

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WELDCO Type 430-T Welded Stainless Steel Tubing was used in the tank muffler shown above. It was chosen for **ALL** the tubular parts because it met the heavy-duty requirements of this application. Firestone Steel Products Co., Akron, Ohio, specified WELDCO Tubing because of its exclusive Double-Fusion Weld and excellent fabricating qualities.

WELDCO Pipe and Tubing are available in Monel, Stainless Steel, Hastelloy, Inconel, Nickel, Cupro-Nickel, and Carbon Steel . . . in sizes 3" and larger, in Schedules 5 through 120. In addition, intermediate wall thicknesses and outside diameters can be produced to your specifications. For any special problems or regular applications, always specify WELDCO — Your Best Buy in Top Quality Tubing.

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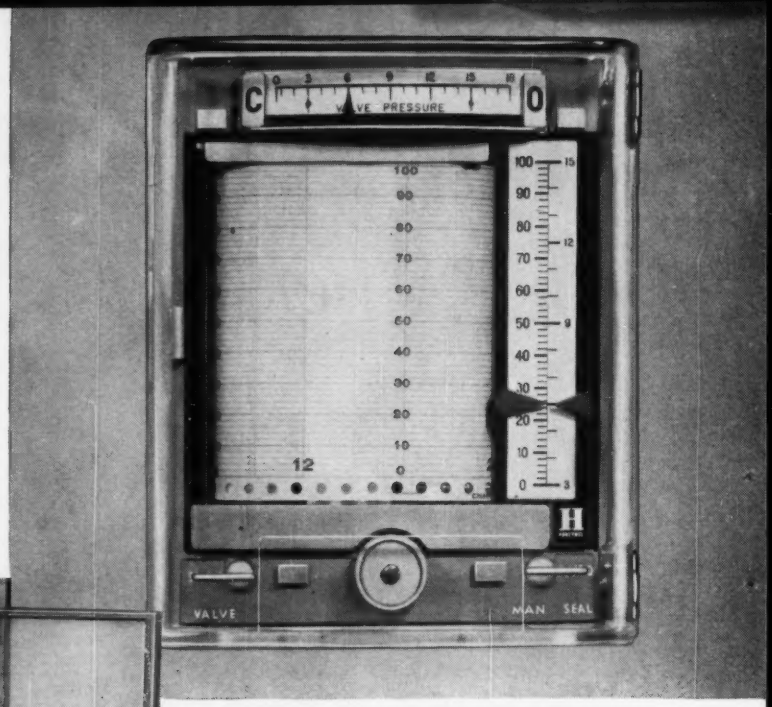
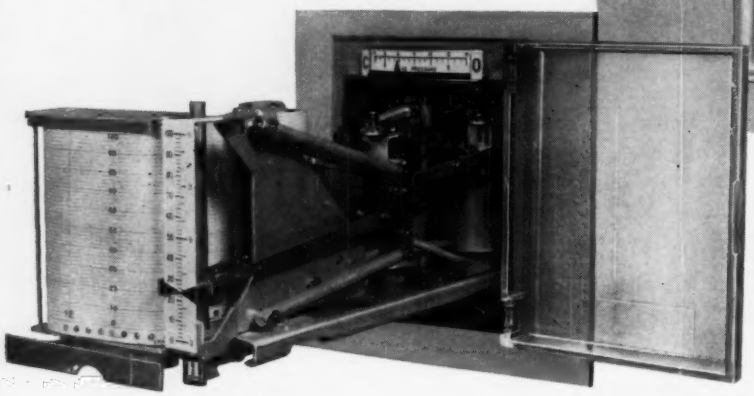
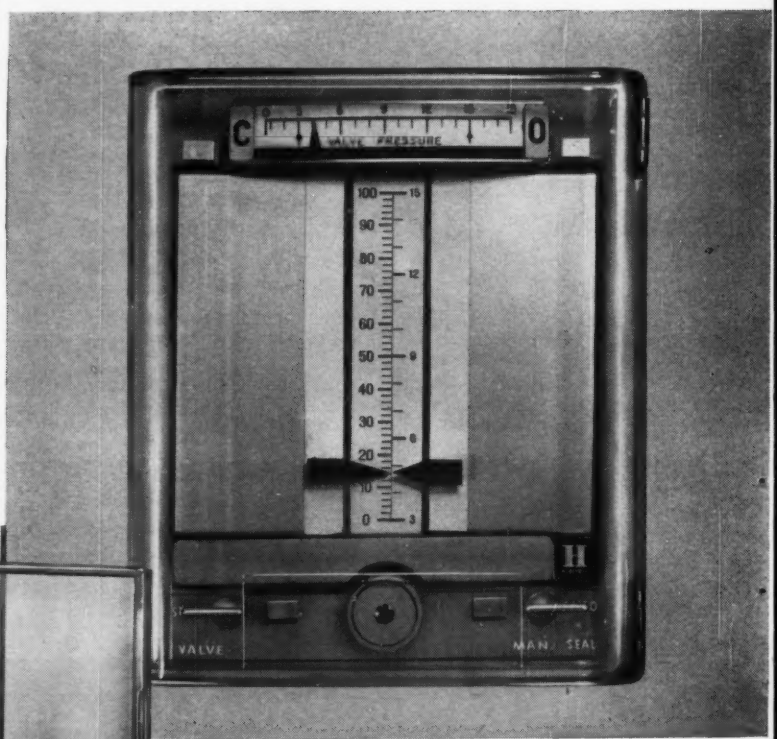


TEL-O-SET RECORDER

takes panel cut-out only 5-1/32" high by 4-9/16" wide. Chassis slides out of case as a complete unit . . . can be shipped separately to prevent damage and collection of dirt or dust awaiting start-up. In partially withdrawn position, the internal mechanism is accessible for adjustments. Uses identical case as indicator. Bottom-of-case location of control knobs permits instrument to be mounted higher on the panel.

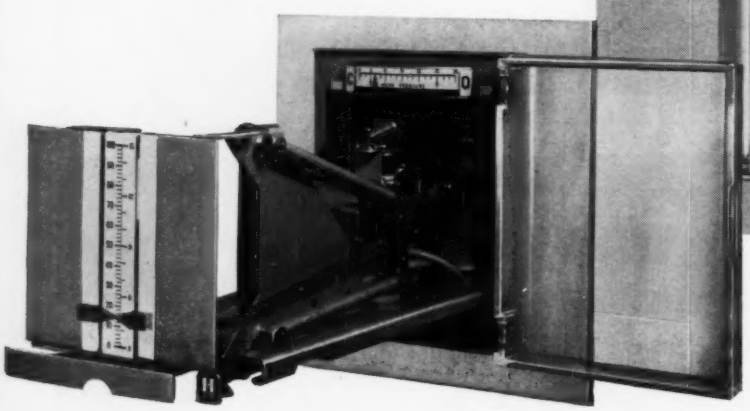


today's



NEW TEL-O-SET INDICATOR

takes same panel cut-out as recorder . . . uses many of the same parts. Less spare parts inventory is required. Note the rugged construction, easily accessible calibration adjustments. Vertical scale makes it easy to compare set point and measured value. Recorder and indicator chassis are completely interchangeable.



● **REFERENCE DATA:** Write for new Bulletin No. 7202.

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Tel-O-Set instruments

give you extra values

Whenever you're planning graphic process control, plan to take advantage of the extra values built into the latest *Tel-O-Set* miniature instruments. These advanced indicators, recorders and controllers simplify installation, service and replacement problems . . . and give you the top in accurate, flexible performance for controlling temperature, flow, pressure and liquid level.

Installation is easier. Case, chassis and controller are separate units. The case can be shipped separately to the point of installation and fully piped and tested . . . for the air to valve gage, regulator and switch assembly remain with the case. These components are readily removed without need for breaking conduit or electrical connections. Panel shipment is simplified, with chassis and controller going directly to the job.

Service is easier. All major parts of the indicator and recorder are identical and interchangeable. Unitized construction of sub-assemblies permits interchangeability of sections of major assemblies. The chassis can be partially or fully withdrawn and remain completely operative. It can be disconnected without losing manual control. Controllers have single-lever, quick-disconnect switch . . . use simple, gasketed, flat, mating surfaces.

Operation is easier. An integral switch provides external reset feedback, air on automatic position or air on manual position of bypass relay . . . permitting use with any force-balance controller of past or present design. Opposing pointers tell the measured value and set point on prominently marked vertical scales. Control knob and transfer switch are conveniently located at the bottom of the case, where the operator can manipulate them without having his hand obscure vision of the pointers and scale.

Precision is high . . . ample for even the most exacting process requirements, with true linear calibration.

For a discussion of applications to your own processes, call your local Honeywell sales engineer . . . he's as near as your phone.

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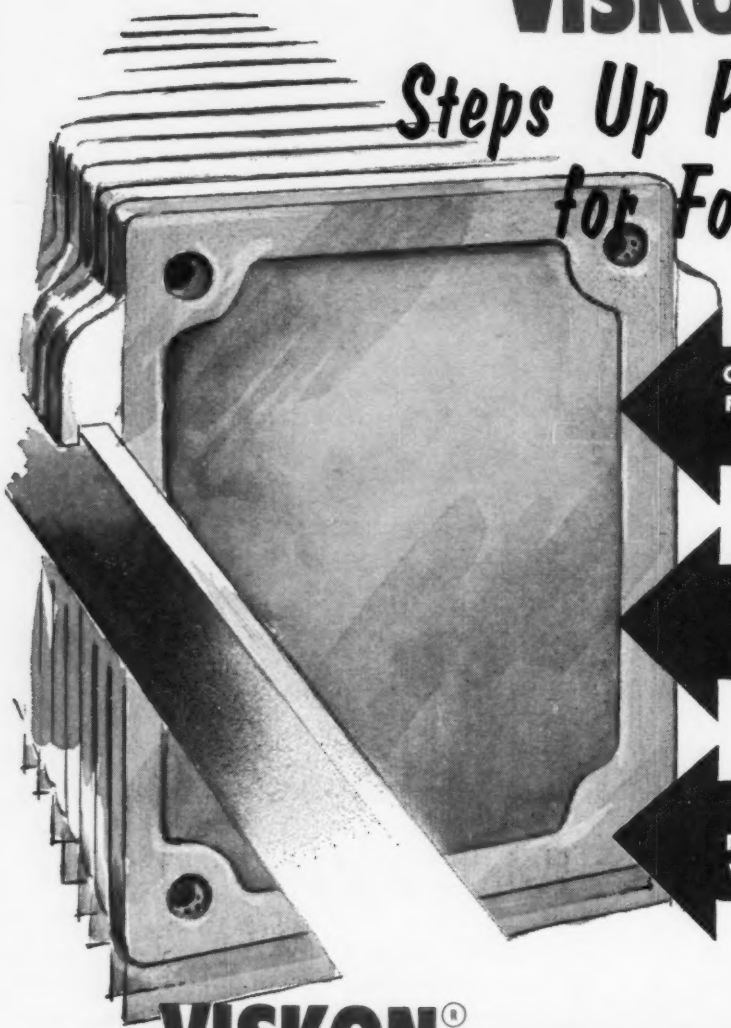
Steps Up Production 25% for Food Processor !

SOURCE: Mr. Raymond Fischer, Fischer Apiaries, North Little Rock, Arkansas



ONLY 15 SECONDS TO REMOVE FILTER CAKE FROM BOTH SIDES OF FILTER FRAME

VISKON CUTS DOWNTIME OF 40 PLATE PRESS FROM ONE HOUR TO 10 MINUTES

FILTRATE MUCH CLEARER, PRODUCT QUALITY INCREASED WITH VISKON FILTER MEDIUM

LET VISKON® SAVE YOU MONEY AND STEP UP YOUR PLATE AND FRAME FILTER EFFICIENCY

VISKON filter fabric lasts longer because of the special bond which protects each nonwoven fiber, yet permits a high degree of flow rate. VISKON has amazing wet strength.

VISKON filter fabric cleans quickly, easily. Frequently the filter cake falls off when plates are released to be cleaned. A low pressure hosing with water usually gets the job done.

VISKON filter fabrics are available in numerous weights and finishes in cotton and synthetic fibers. They are insoluble in common organic solvents and can be backwashed on line operations.

VISKON filter fabric saves you money! You save on downtime. You save on material cost even when you throw away VISKON filters. Yes, here is a new filter medium to save you money on materials and labor—yet gives you better operating efficiency!

Use This Handy Coupon Or
Dictate Your Inquiry Letter To:

Mr. A. I. Pierce, Filter Media Engineer
THE VISKING CORPORATION
P. O. Box 72 • • North Little Rock, Arkansas

NAME_____
ADDRESS_____
CITY_____ ZONE____ STATE_____
Type of Filter Press_____

VISKON®
nonwoven fabrics

DE LAVAL
OPPELLER PUMPS

last longer... cut maintenance costs

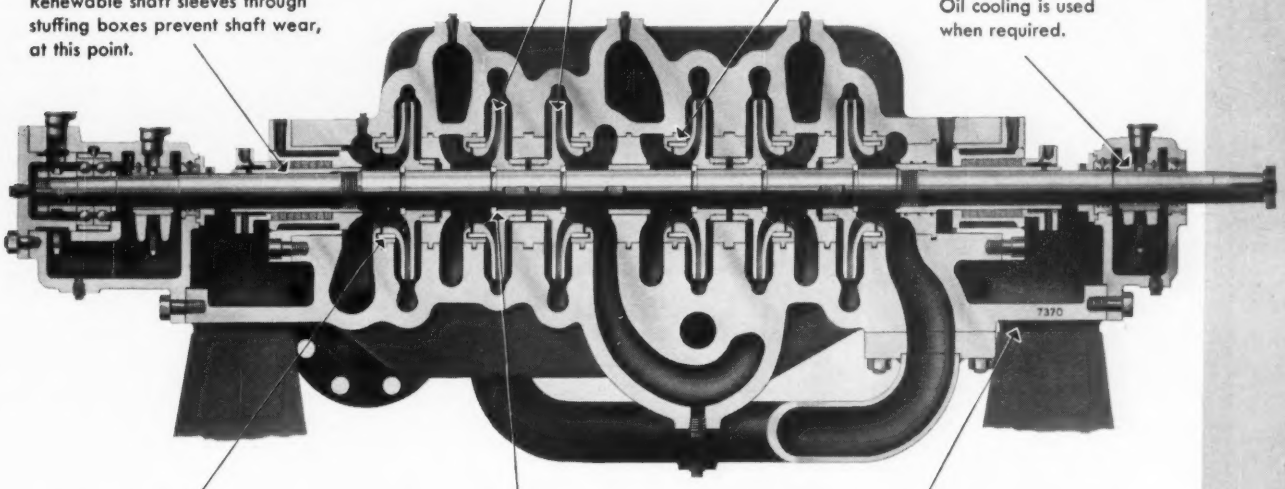
Stages are arranged to reduce differential pressures between stages. This insures permanent sealing at the casing-joint and at interstage diaphragms.

Pairs of back-to-back impellers balance axial thrust. One-purpose thrust bearing carries no radial load, maintains axial alignment.

Labyrinth wearing rings permit safe clearances and reduce wear.

All bearings are ring-oiled, sealed against contamination by water or dust. Oil cooling is used when required.

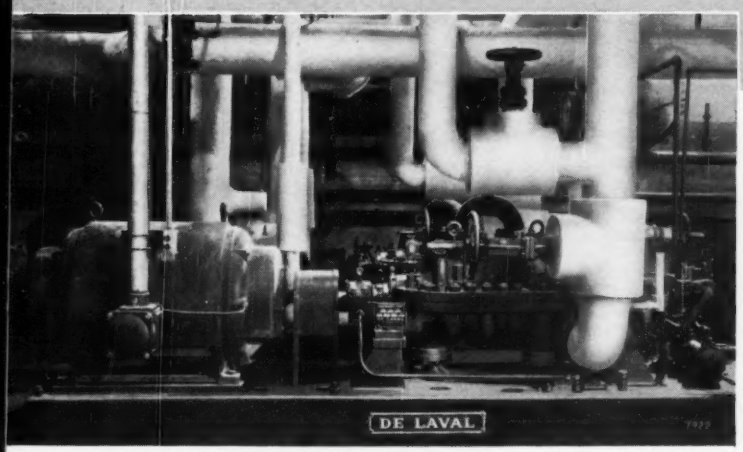
Renewable shaft sleeves through stuffing boxes prevent shaft wear, at this point.



Threaded impeller wearing rings make replacement easy without heating or damage to impellers.

Individual impeller mountings, with split locating rings, make interstage shaft sleeves unnecessary. Impellers can't shift with shaft expansion and contraction.

Casing support insures coupling alignment at any operating temperature.



Here are two De Laval 6-stage Oppeller Pumps used for boiler feed service in an industrial installation.

The design features above show clearly why De Laval Oppeller Pumps stay on the line longer and cost less to maintain. These pumps are used for boiler feed, hydraulic systems, descaling spray, mine dewatering, refinery oil pumping and similar services.

De Laval Oppeller Pumps are available in sizes from 2 to 4 inches and 2 to 8 stages; capacities to 1000 gpm, pressures to 1200 psig and temperatures to 3500F. *For complete data, write for De Laval Catalog 1502.*

DE LAVAL *Oppeller Pumps*

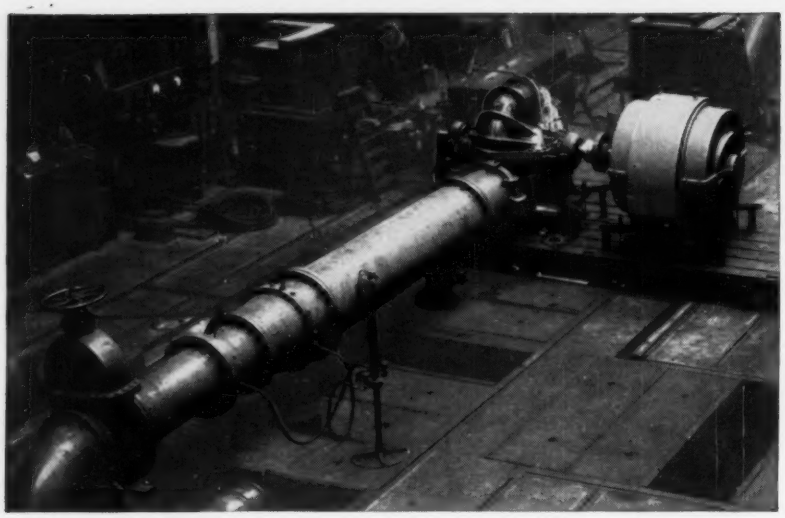
DE LAVAL STEAM TURBINE COMPANY

803 Nottingham Way, Trenton 2, New Jersey

OL2§6

Keep your eye on WORTHINGTON

Pump research primes pump progress



TEST STAND CAPACITY UP TO 100,000 GPM is provided at Worthington's Harrison plant *(above)*. Built over a man-made half-acre lake, the test stand is used as a production tool to check pumps from fractional horsepower up. This flexibility comes in handy—in one line alone Worthington can put together 60,000 different standard pumps out of 650 parts in six standardized sets of liquid ends.

DIRECTING PUMP TEST OPERATIONS from central control room *(left)* where special measuring instruments speed collection of performance data. Worthington pump specialists can afford to be objective in considering your pump application problem. They select from the most complete line of pumps offered by any manufacturer.

We have a lot of experience at Worthington—more than 114 years of it—and we're picking up more all the time.

But technology advances every day. Each step forward brings with it new and unsolved pumping problems. That's why Worthington's research and development program is continuous. That's also why we like to work with you during planning to get the jump on problems before they reach the costly stage.

Experts for every problem

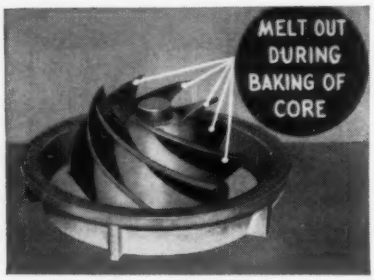
For your day-to-day pumping problems, our sales engineers are thoroughly trained in pump applications in every field, and can usually supply the right answer fast. Naturally, for the really tough ones, our staff engineers back them up with all the equipment and facilities of our shops and laboratory. In addition, factory-trained troubleshooters are available to cope with any problem that may arise in the field.

From cat-cracker to atom-cracker

Our specialists, covering all major industries, work as a team. Together, they bring to bear on any problem a vast store of experience. They've successfully solved pumping problems and helped pioneer new developments in public works, atomic energy applications, the oil industry, and the chemical industry —to name a few.

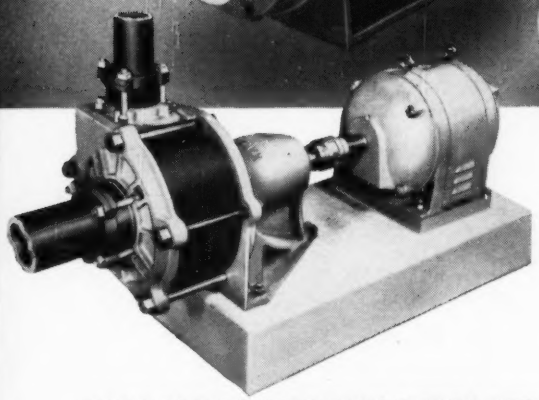
So keep your eye on Worthington; we probably have a money-saving answer to your pumping problems. C.5.1

WORLD'S FIRST ATOMIC-POWERED SUBMARINE, *NAUTILUS*, undergoing sea trials. In atomic development since 1941, Worthington recently built special engine room equipment for both atomic submarines, *Nautilus* and *Sea Wolf*. Worthington continues to figure prominently in supplying this new field of atomic energy, keeping pace with its new and rapidly changing requirements.

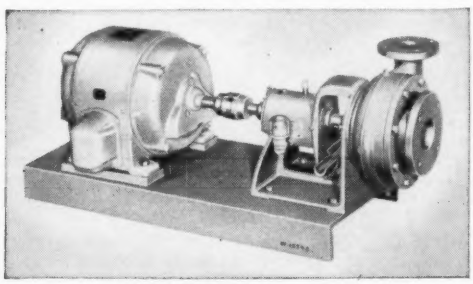


EUTECTIC CASTING, used in making standard Worthington pumps, frees engineer from casting restrictions. Formerly, design of impeller and diffuser blades had to allow hand withdrawal from fragile sand core. Eutectic casting uses a low-melting-point alloy to form blades, melting this alloy out during baking. This permits design flexibility for maximum hydraulic performance.

VITALITY OF WORTHINGTON RESEARCH PROGRAM is shown by the more than 300 articles in the technical press during the past five years by Worthington people. This flood of informative technical literature not only reflects our ability to keep pace with the changing hydraulic requirements for modern pumps, but also highlights the important contributions by Worthington to the knowledge of pumps.



FAMOUS KARBATE* NON-METALLIC CHEMICAL PUMP, made of impervious graphite by National Carbon Company. Now you'll be able to buy this pump from Worthington. Karbate pumps include motor-mounted (close-coupled) and frame-mounted units with capacities ranging from 5 to 1500 gpm at heads to 110 feet at conventional motor speeds.



WORTHITE TYPE CNG CENTRIFUGAL CHEMICAL PUMP. Super-stainless Worthite provides best all-round metallic corrosion resistance in a standard pump. Manufactured in 27 standard sizes, it assures you of complete hydraulic coverage up to heads of 235 feet and capacities of 2500 gallons per minute. Worthite type CNG pumps are available with standard stuffing boxes, with Teflon seal cage arranged for independent cooling liquid, or with external mechanical seal.

Now Worthington offers you the widest standard corrosion-resistant pump line

as Karbate* impervious graphite supplements Worthite

Worthington Corporation is now marketing Karbate brand centrifugal pumps, manufactured by National Carbon Company, a Division of Union Carbide and Carbon Corporation, in addition to our Worthite centrifugal chemical pumps.

In Karbate pumps, parts in contact with the liquid pumped are made of impervious graphite, making the pumps applicable for many corrosive services where conventional metals or alloys are unsuitable.

Worthite pumps already form the broadest line of metallic centrifugal pumps in the industry. This coverage is now completed by the addition of the non-metallic Karbate Brand Impervious Graphite Pumps. You'll find Worthite and Karbate pumps your best bet for virtually 100 percent of corrosive applications.

Worthite is a high-nickel, high-chromium, molybdenum alloy steel, with 0.07 percent maximum carbon content. It is stainless and its stabilizing elements tend to prevent intergranular corrosion.

Write today for copies of bulletins W-350-B14A and W-350-B18 describing in detail Worthite and Karbate centrifugal chemical pumps. Worthington Corporation, Harrison, New Jersey. C.5.1A

*Reg. Trademark of Union Carbide and Carbon Corporation.

WORTHINGTON

THE WORLD'S BROADEST LINE
ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

CENTRIFUGAL • ROTARY • STEAM POWER • VERTICAL TURBINE

Rockwell-Nordstrom
LUBRICANT

Rockwell-Nordstrom Valves Prove Lubrication Is The Cheapest Maintenance!

● LUBRICATION ELIMINATES METAL-TO-METAL FRICTION

—the major source of valve wear. As in your automobile engine, lubrication assures longer life and better performance. Pressurized lubricant also forms a remarkably leakproof seal between the plug and the valve body. This lubricant seal has proven far more effective than the uncertain metal-to-metal seal in ordinary valves where a tiny scratch means leakage . . . and eventually, expensive reseating.

Costly valve down time is practically eliminated with Rockwell-Nordstrom valves because lubrication stops trouble before it starts. The lubricant also hydraulically jacks the plug to eliminate stuck or jammed valves, assures *instant*, quarter turn operation.

● LUBRICATION IS FAST...EASY

Rockwell-Nordstrom valves can be lubricated either with a pressure gun directly through the standard Rockwell fitting or by unscrewing the fitting and inserting lubricant "sticks." Lubrication never requires valve down time because any Rockwell-Nordstrom valve can be lubricated under service pressure.

Like any lubricated mechanism, frequency of use and operating conditions are the determining factors in the lubrication schedule. In any case, the time it takes to lubricate a Rockwell-Nordstrom valve is an investment in trouble-free, long-life valve service.

● LUBRICATION PENNIES SAVE MAINTENANCE DOLLARS

A few cents worth of lubricant buys three things: 1. *new seats* (renewing the lubricant is like reseating an ordinary valve) . . . 2. *smooth, dependable operation* and . . . 3. *savings* in terms of lower repair, replacement and down time expenses. It is not the cost of the lubricant that is important, but the *savings* through longer, more dependable life of the working parts and better performance.

● GENUINE ROCKWELL-NORDSTROM LUBRICANTS are specially compounded to not only reduce friction, but also to create a positive, leakproof seal. They are the result of 40 years of production "know-how" and field testing by the pioneer lubricated plug valve manufacturer. Their sole purpose is to insure that Rockwell-Nordstrom valves give you the best valve service you've ever had. That's why it's good business to use *only* genuine Rockwell-Nordstrom lubricants in Rockwell-Nordstrom valves.

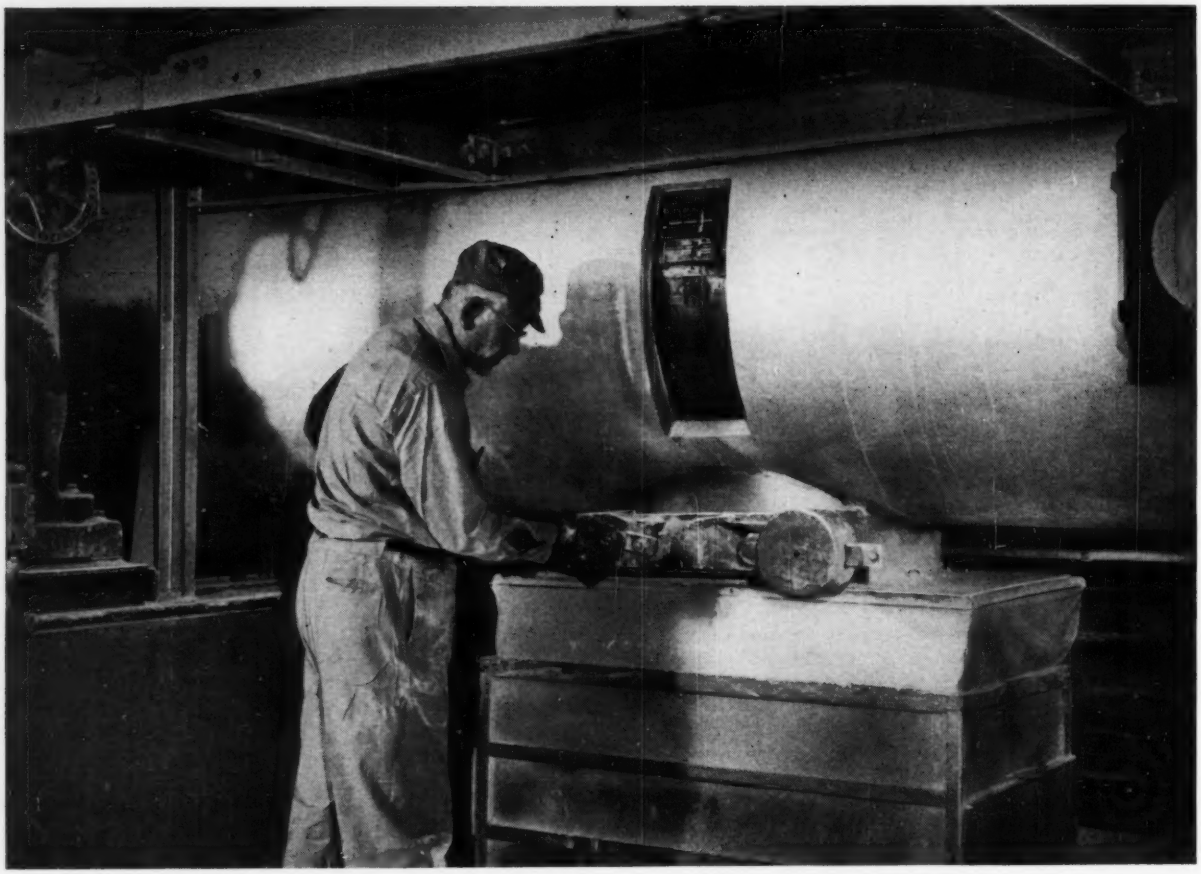
● 40 YEARS OF PERFORMANCE PROVE that Rockwell-Nordstrom valves are the most economical valves you can buy for *any* service. Over the years, the sale of repair parts has been less than one-half of one per cent of Rockwell-Nordstrom valve total valve sales . . . *for every two dollars users spend on Rockwell-Nordstrom valves, they spend less than one penny for repairs.*

Whatever your needs, there is a Rockwell-Nordstrom valve that will do the job with more trouble-free dependability and at lower cost per year than any other valve you've ever used. And the first cost of Rockwell-Nordstrom valves is no more (and often less) than the cost of ordinary valves! For more information, write: Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Canadian Valve Licensee: Peacock Brothers Limited

ROCKWELL-Nordstrom VALVES

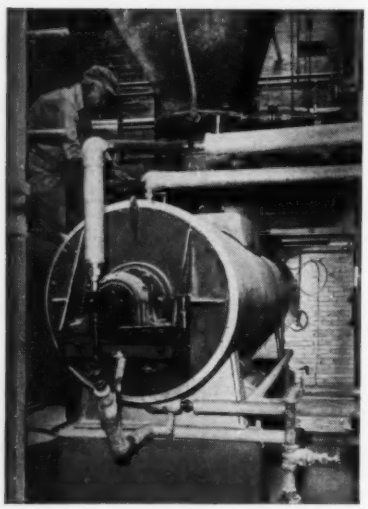
LUBRICANT SEALED FOR POSITIVE SHUT-OFF



G-11® (brand of hexachlorophene) is dried uniformly to less than 1% moisture content in Stokes rotary vacuum dryers

STOKES rotary vacuum dryers vital to processing of G-11®

Sindar product dried at low temperatures on round-the-clock production schedule.



Two Stokes rotary dryers run 24 hours a day at the Givaudan plant in Delawanna, N. J.

In the fight against bacteria, G-11® (brand of hexachlorophene), developed by the Givaudan Corporation and marketed by its associate, Sindar Corporation, is doing for the skin what antibiotics are accomplishing in internal medicine. From an initial application in operating room "scrub-up" soaps, the product has found ever-widening application in cosmetics where its unique "cleanliness that clings" gives valuable antiseptic and deodorant qualities to creams, lotions and soaps.

Because of the need for low-temperature drying, laboratory and pilot-plant investigations with G-11® were carried out in Stokes vacuum shelf dryers. To meet the growing demand for this product, two Stokes vacuum dryers now operate 24 hours a day.

Stokes has had vast experience in the design and application of chemical processing equipment. Your particular problem will receive careful consideration, based on this broad background.

For an informative brochure on Vacuum Drying, write for Catalog 720. For complete information on how the Stokes Advisory Service and Laboratory can help you, send for Bulletin 640.

F. J. Stokes Machine Company, Philadelphia 20, Pa.

OFFICES IN PRINCIPAL CITIES, REPRESENTATIVES THROUGHOUT THE WORLD

STOKES

If you **MUST** stop Corrosion

KEL-F® PLASTIC WILL

KEL-F Plastic Molded and Fabricated Valve Linings, Valve Diaphragms, Gaskets, Ring Seals, Gauge Crystals, KEL-F Dispersion Coated or Laminated Lined Tanks, Vessels, Reactors, Piping and Tubing can protect your plant equipment against chemical corrosion

KEL-F Fluorocarbon Plastic is the best non-permeable, corrosion-proof material available today. It is inert to virtually any type of chemical attack—including mineral acids, oxidizing agents as well as strong caustics. When nothing else will protect equipment, KEL-F Plastic usually will.

HERE ARE SOME OF ITS OUTSTANDING CHARACTERISTICS:

Temperature Tolerance

Exhibits satisfactory properties over a temperature range of approximately 710°F. (−320°F. to 390°F.)

High Compressive Strength

Pressures of 8,000 psi result in only 4% to 5% permanent set. Line seals are retained longer when gaskets and O-ring seals are made of KEL-F Plastics.

Non-Adhesive

KEL-F Plastic is non-wetting even after long periods of immersion. Surface is anti-fouling when in contact with even the most viscous liquids.

KEL-F Plastic is a thermoplastic and easy to fabricate. It is readily molded by extrusion, transfer and injection. Available in sheets, rods, tubing and film, it can be fabricated, heat formed, machined and heat-sealed by a growing list of experienced fabricators.

New! KEL-F Plastic Dispersions

KEL-F Plastic Dispersions have been developed for bake-coating of metallic surfaces that must be corrosion resistant, anti-adhesive and electrically non-conductive. These Dispersions can be applied by spraying, spreading or dipping.

The full story of what KEL-F will do for you is worth having. Write or call for additional information.

THE M. W. KELLOGG COMPANY

Chemical Manufacturing Division,
P. O. Box 469, Jersey City, N. J.

SUBSIDIARY OF PULLMAN INCORPORATED

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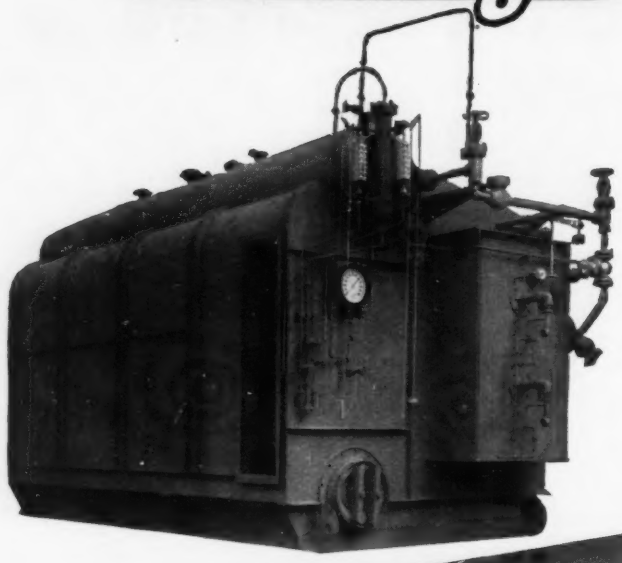
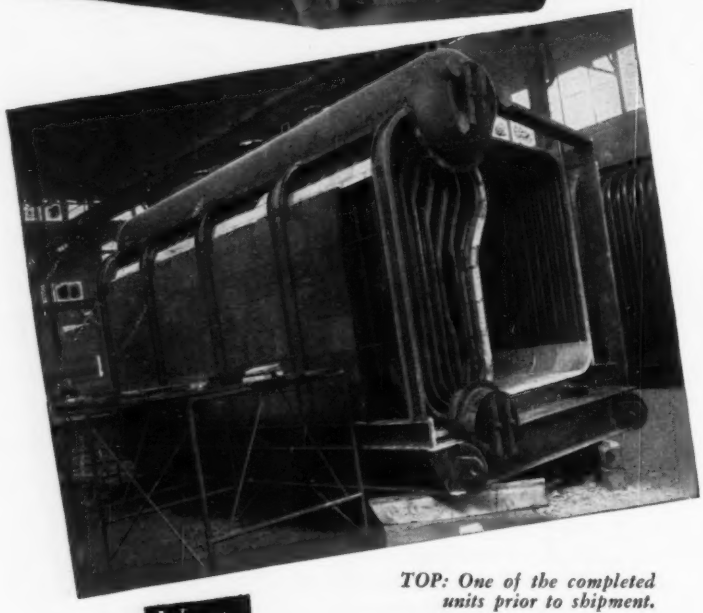
Vogt

Gas Fired
PACKAGE UNIT
Steam Generators
selected by
PHILLIPS CHEMICAL CO.
Pasadena, Texas Plant





TOP: One of the completed units prior to shipment.

BOTTOM: Shop erection view shows tile and block insulation in convection wall; also main baffle tile and furnace floor tile.

Principal Data, Each Unit

25,000 pounds steam per hour capacity. Induced draft type.
Fusion welded steam and water drums designed for 425 pound S.W.P.
Completely shop assembled and required only the piping and gas outlet connections to place them in operation.
Fully steel encased for outdoor installation on a simple foundation.

•

★ *Vogt Steam Generators are available in bent tube types and straight tube forged sectional header types for solid, liquid or gaseous fuels. Bulletins on request.*

HENRY VOGT MACHINE CO.
Louisville, Kentucky

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

Chemical Engineering
OCTOBER 1955

Watch for . . .

Your 1955 Inventory Issue

. . . Briefs on 1,500 of the year's most important developments in new processes, plants, chemicals and equipment . . . plus a 2,700-item checklist of manufacturers' literature.

. . . A timely inventory, a permanent reference.

WITHIN a few weeks you'll be getting your copy of our 2nd Annual Inventory issue—a special, 13th issue introduced last year as a new type of reference service for chemical engineers everywhere.

You'll see several changes this year. They're largely improvements and refinements passed along by readers and by some 6,200 CE subscribers selected for special opinion surveys.

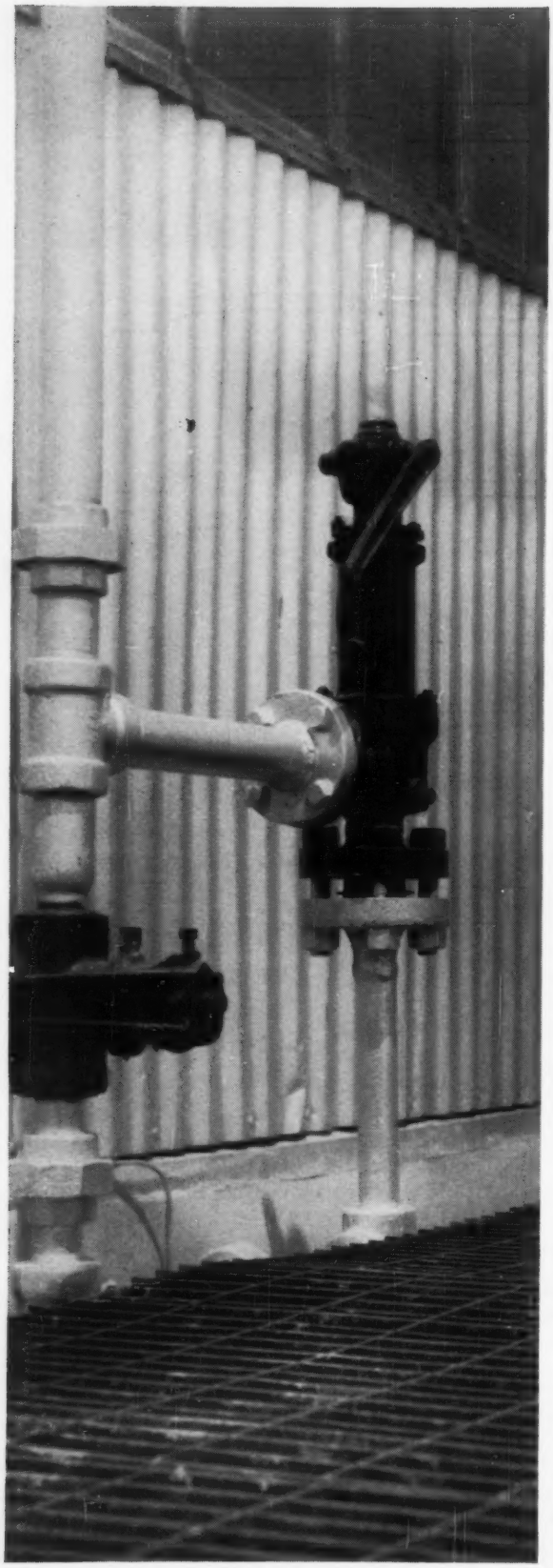
For one thing, we've worked out a new Master Index to all equipment, chemicals and materials covered editorially and in advertisements. You'll find this a quick reference to almost 5,000 items—by far the most complete index of its kind available to chemical engineers and prepared especially for chemical engineers.

We've expanded several sections, including the popular 2,700-item Inventory of Technical Literature. And we've worked in format refinements aimed at our original objective of making all material easy to find, scan, digest, follow up for more information. We've pulled no stoppers on that score.

Last year's Inventory issue went over far better than we'd ever hoped for. But we want to get better still. So we'd appreciate any tips you may pass along on how we can make this special issue even more useful to you and to our 40,000-odd subscribers throughout the chemical process industries.

Watch for your copy of CE's 2nd Annual Inventory issue. Use it during the coming year as a timely reference, save it as a permanent reference.

John R. Callaham



WITH RELIEF DEVICES . . .

How to Protect Your

Pressure relief devices are essential for fire and explosion prevention. Here is practical information on what devices are available, and the best way to use them.

C. G. WEBER, Farris Engineering Corp.

Overpressure protection, through the use of primary safety relieving devices, is the first line of defense against explosion or failure of pressure vessels.

These devices are safety valves, relief valves, frangible disks (rupture disks), and combinations of safety valves and rupture disks. Each has its purpose, but the common denominator is cognizance of the fact that every pressure vessel in your plant is a potential bomb.

Hazards are not necessarily limited to flammables. One large chemical plant reports that its most serious explosion involved entrance of critical chemical traces into a water tank. Case histories of hot-water boiler explosions also verify this thinking.

The consequences of serious injury to personnel, even possible loss of life, preclude dependence on an insurance policy. With due recognition of the indispensable functions of the applicable codes, inspections, and regulatory agencies, it is necessary to police your own installation and maintenance procedures. From a financial aspect alone, insurance cannot compensate for disruption of production and other effects of pressure vessel failure or safety valve malfunction.

A second line of defense is adequate fire protection. This subject is beyond the scope of this article, yet it should be considered. The petroleum refining industry has done an outstanding job, in compiling data for publication, of a recommended practice bulletin, soon to be released by the American Petroleum Institute.

The pertinent point is that a pressure vessel may fail at pressures lower than the maximum allowable working pressure used in design because of reduction in tensile strength caused by exposure to fire. Insulation, water spray, and depressuring facilities are some of the methods which offset this effect. Pressure vessels can fail in a fire, even though adequately protected against overpressure.

How to Select Safety Devices

First consideration in selection is type and construction. The best available equipment for the required inlet, outlet and invironmental conditions should be purchased. Compromise at this point often results in false economy, hazard, maintenance problems and process upsets.

Pressure Vessels

Compliance with applicable national and local codes must also be considered. Acceptance, and enforcement of the various codes, however, varies considerably.

Safety relieving devices may be classified generally as follows:

- Safety valves for steam generator service comply with ASME Power Boiler Code, Section 1, 1952. This includes boiler drum safety valves, superheater safety valves and all steam boiler safety valves for operation at pressures exceeding 15 psi.
- Safety and relief valves in sizes $\frac{3}{4}$ in. to $4\frac{1}{2}$ in. inclusive, on boilers used exclusively for low-pressure steam, (15 psi. max.) hot-water heating and hot-water supply (150 psi. max.) comply with ASME Low-Pressure Heating Boiler Code, Section 4.
- Safety relieving devices, ferrous and non-ferrous, for unified pressure vessels often comply with ASME Unified Pressure Vessel Code, Section 8, 1952. Certification and testing by the National Board of Pressure Vessel Inspectors is not required for liquid relief valves.
- Safety relieving devices, ferrous specifically, for unfired pressure vessels in the petroleum industry usually comply with the joint API-ASME Unfired Pressure Vessel Code for Petroleum Liquids and Gases, 1951. Certification by test of liquid relief valves is not required.
- Safety relieving devices handling liquefied petroleum gases are in a special category covered by the National Fire Protection Association, pamphlet 58.

Many other special categories are covered by publications of the Interstate Commerce Commission, American Association of Railroads, Chlorine Institute, Factory Mutual Laboratories (fire pump relief valves), U. S. Coast Guard, several states, Canadian provinces, users, etc.

It is strongly recommended that each user maintain an up-to-date file of all applicable codes.

What Devices Are Available?

Having determined the effect of code requirements, if any, we consider next the choice of relieving device.

A *safety valve* is an automatic pressure-relieving device actuated by the static pressure upstream of the valve and characterized by full opening or "pop action" upon opening. It is used for gas or vapor service. Rated capacities are attained at overpressures of 3%, 10%, or 20%, depending on code.

Construction always includes either an adjustable blowdown ring or a predetermined machined equivalent to form a "huddling chamber" for pop action.

The term safety valve does not necessarily imply compliance with any code.

A *relief valve* is an automatic pressure-relieving device actuated by the static pressure upstream of the valve, and which opens in proportion to the increase in pressure over

Some Important Definitions

Safety Valve

An automatic device actuated by the static pressure upstream of the valve and characterized by full opening or "pop" action. Used for gas or vapor service. Construction always includes a blown-down ring or predetermined machined equivalent, which forms a "huddling" chamber for pop action.

Relief Valve

A device which opens automatically in proportion to the increase in pressure over the set pressure. Used primarily for liquid service. There is no huddling chamber, and no pop action.

Safety-Relief Valve

Can be used for compressible and incompressible fluids. On liquid service the blowdown ring is made inoperative.

Rupture Disk

A thin metal sheet, held between flanges, is designed to burst at a maximum pressure or temperature.

Safety Valve-Rupture Disk

A combination, where the disk can be placed in either the outlet or the inlet piping.

Balanced Safety Valve

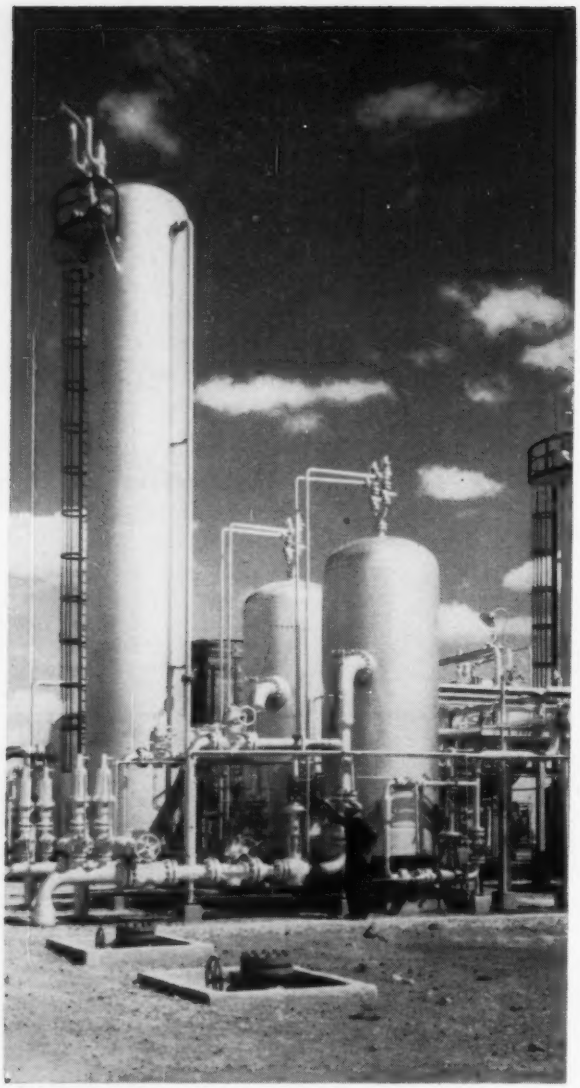
A design where outlet line back-pressure has little effect on the valve set pressure.

Accumulation

Pressure increase over the maximum allowable working pressure of the vessel.

Overpressure

Pressure increase over the set pressure of the primary relieving device. Same as accumulation when the relieving device is set at the maximum allowable working pressure of the vessel.



RELIEF DEVICES—no stranger to process industries.

the set pressure. It is used primarily for liquid service. The rated valve capacity is usually attained at 25% overpressure.

Construction does not require a huddling chamber, but provides an overhanging "umbrella" shape or diaphragm for lift. Full and semi-nozzle type valves are often called "safety-relief valves" because they can be used for either compressible or incompressible fluids. When used for liquid service, the blow-down ring is usually adjusted downward, making it inoperative.

A *rupture disk* consists of a thin metal sheet held between flanges. It is designed to burst at a maximum pressure (and temperature) not to exceed the maximum allowable working pressure of the vessel.

The chief advantages of a rupture disk are tightness, economical use of corrosion-resistant materials, and the absence of moving parts.

A rupture disk is often selected for handling fluids that may render a safety or relief valve inoperative, or where a loss of valuable material by leakage should be avoided, or where contamination of the atmosphere by leakage of noxious gases must be avoided.

Disadvantages are complete loss of vessel pressure; the requirement of heavier-walled vessels to offset the wider popping tolerance; fatigue where vessel pressures fluctuate; reduction of set pressure due to corrosion, and relatively short corrosion life of the thin membrane, compared with a safety or relief valve of the same material.

Combinations Are Useful

Safety valve—rupture disk combinations sometimes can be employed to advantage, installing the disk or safety head at the valve inlet, outlet, or both. Such installations require more than the usual precautions. The user should refer to the Unfired Pressure Vessel Code, ASME or API-ASME for complete instructions. The following footnotes are significant.

For a rupture disk between vessel and safety valve: "Users are warned that a rupture disk will not burst at its design pressure if backpressure builds up in the space between the disk and the safety or relief valve, which will occur should leakage develop in the rupture disk due to corrosion or other cause." (Suitable venting is required).

Rupture disk on the outlet side of safety valve: "Users are warned that an ordinary spring-loaded safety or relief valve will not open at its set pressure if backpressure builds up in the space between the valve and the rupture disk. A specially designed safety or relief valve is required such as a diaphragm valve or a valve equipped with a bellows over the disk." (The reference is to balanced valves, primarily).

More Construction Features

There are some additional construction features to consider before making a final selection of a safety or relief device. In each case the manufacturers catalogs should be consulted for specific type numbers, connections, and pressure-temperature limits.

Valves which may be exposed to fire are specified as steel, alloy steel or stainless steel. Cast iron, ductile iron, bronze, rubber, synthetics, plastics etc. are not used.

Valves for viscous liquids which solidify at normal temperatures are best specified with a built-in heat exchanger (steam coil) in the body to avoid steam tracing, and preferably with bellows to prevent sticking of moving parts. Top guided construction is preferred. However, in some cases where economy is a major factor, and inlet temperatures are maintained appreciably higher than the freezing point, wing-guided valves perform satisfactorily.

For slurries and other erosive services with entrained solids, valve seats or disks of rubber or synthetics are highly recommended for longer service life and tighter seating. When set pressures are too high for soft seats or diaphragms, knife-edge seating surfaces of hardened material are usually specified.

Safety and relief valves required to operate against back

pressure deserve special consideration in selection and installation. Constant back pressure is covered under installation, discharge piping. Variable back pressures exceeding 10% require balanced valves, with a capacity correction if back pressure exceeds the critical for vapors.

Corrosion problems are best handled by selection of a top-guided valve with moving parts protected by a diaphragm or bellows of suitable material. The remainder of exposed parts are usually specified from the standard or sub-standard trim schedules stocked by the manufacturer.

Generally speaking, the manufacturer has available a representative range of corrosion-resistant materials for all parts exposed to the lading fluid, in various valve types. Manufacturing and design limitations narrow the choice of materials for bellows and diaphragms, compared with other valve parts. Resistance to external atmospheric corrosion is usually handled on a special basis.

How to Install Safety Devices

Important points to remember on inlet piping are:

To avoid chatter, design for 2% maximum pressure drop due to friction loss. This means 2% of the set pressure and is equivalent to approx. ½ the blowdown.

Install valves directly on the vessel wherever possible, or keep inlet piping as straight and short as possible. If elbows are required, use only long radius type .

Do not install effluent laterals from safety valve inlet piping because adverse pressure drop conditions can develop.

Do not install safety valves at or near condenser headers or other piping producing sharp reversals of flow.

For stop valves on safety valve inlets, the discharge area must not be less than the corresponding inlet pipe cross-sectional area. Second, pressure drop must be determined and included with inlet piping. Example, a 2 in. globe valve would "starve" a 2 in. relief valve.

When closed discharge systems are used, compute thermal stresses on valve inlet piping.

Inlet piping or vessel nozzle should never be smaller in area than valve inlet size, not orifice size.

Vent inlet rupture disks as per code.

On discharge piping:

Pressure drop or variations in back pressure should not exceed 10% of the valve set pressure, for conventional valves. This can be as high as 80% for "balanced" valves, but consult mfr. data for capacities.

Use only balanced valves, preferably bellows type, for outlet rupture disks.

Avoid sharp bends, etc., which cause turbulence.

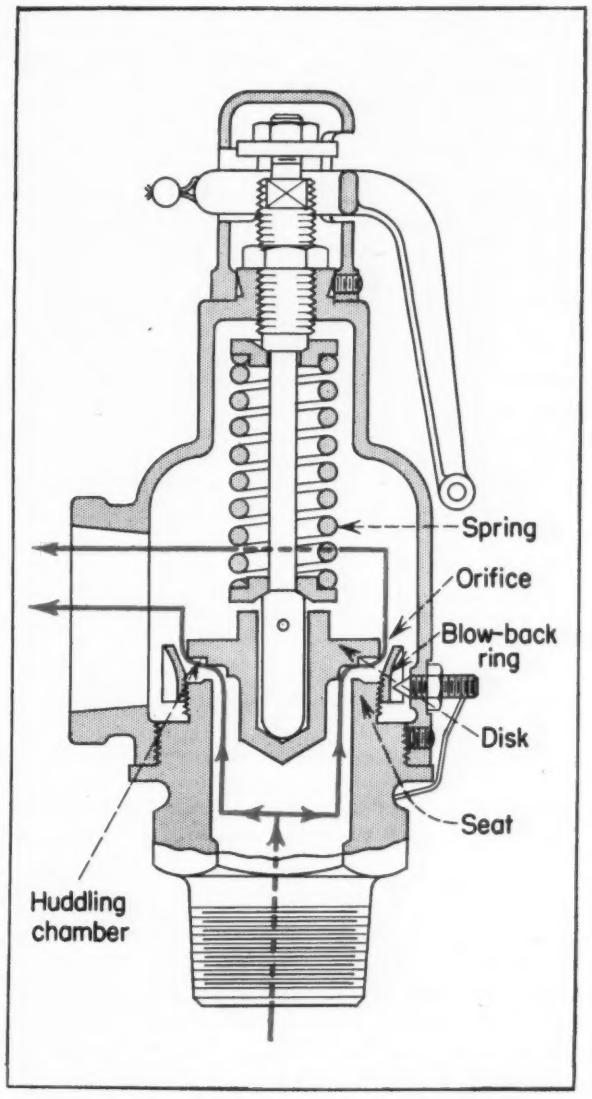
On valves protecting pumps and compressors, discharging to suction, note that if suction pressure varies, a conventional valve will vary widely in pop point. Balanced valves are often used for this reason.

These points are often overlooked:

Provide a 10% spread between operating pressure and set pressure, especially if vibration is present.

A safety or relief valve must develop overpressure to pass any capacity.

A safety or relief valve must have "blowdown" to reseat. To compensate for superimposed back-pressure remember that all valves except balanced types are normally compensated but not on the differential—"C" constant depends on design and construction of valve. A special nameplate is usually used, clarifying the net spring setting.



TYPICAL SAFETY VALVE, with disk in open position.

A formula used by the Farris Engineering Corp. to determine the net spring setting for any valve, except a BalanSeal bellows valve:

$$P_o = P_1 - CP_2$$

P_o = Net spring setting (psig)
P_1 = Inlet set pressure (psig)
P_2 = Back pressure (psig)
C = Valve constant of unbalance (Negative if lowering set point).

$$= \frac{\text{Outlet exposed area}}{\text{Inlet exposed area}}$$

When specifying valves, state if back pressure is variable or constant, superimposed or built-up. If constant, verify that compensation is desired.

A Widely-Held Misconception

Several years ago, during the course of its studies and tests on the subject of variable back pressure and balanced valve design, Farris Engineering discovered a widely-held misconception about the magnitude of compensation required for conventional valves discharging against an initial, superimposed back pressure.

It was commonly believed that the net spring setting required was the difference obtained by subtracting the gage back pressure from the gage inlet set pressure required. Although this is a convenient approach, it could only be correct for a conventional poppet type valve, having a pressure-tight bonnet (not vented) and so designed that the width of the seating surface is zero. Of course, these conditions can never be met 100%, because flat seated valves have a definite, controlled annular seating area and bevel seated valves have an indefinite area of contact whose width depends on the degree of lapping and brinelling.

Actually, the area exposed to back pressure is greater than the area exposed to inlet pressure, the difference assisting the spring load.

The error introduced by the false assumption usually tends to make the valve pop higher than intended, thereby often escaping unnoticed. Field adjustment by the operator possibly corrected some difficulties encountered.

Fortunately, the error on most large valves operating against relatively low percentage back pressure is small. However the error could be as much as 30% to 50% on small high-pressure valves, valves with vented bonnets, wide-seated valves, some unbalanced bellows valves, etc. When properly evaluated, sometimes a negative net spring setting results, making a change of specification mandatory to employ knife-edge seats, diaphragm relief valves, balanced bellows valves, or other devices.

The thing to do is use tabulations of "C" constants for all types and sizes in conjunction with the above formula, resulting in a proper installation when back pressure condition is specified. However, the principles outlined apply to all safety and relief valves. The value of C approaches unity for valves with line-seat contact and becomes zero, canceling the second term, for balanced valves.

C. G. WEBER joined Farris Engineering Corp., Palisades Park, N. J., in 1945. He is chief engineer and director of research. Following his education at Newark College of Engineering, Rutgers and New York University, he engaged in floodlight and marine searchlight design and engineering at Bart Laboratories, before connecting with Farris.

General Precautions

In general keep these points in mind on installation:

1. Always install valves vertically.
2. Valves installed on headers back-thrust, causing a torsional stress on header. Evaluate, and minimize effect by discharging in a direction closely paralleling the header flow.
3. Use drain plugs provided in body, where possible. Do not allow liquid to collect on discharge side of valves on compressibles, if this situation can be avoided.
4. On liquid valves guard against pump pulsations, not water hammer.
5. Never use safety or relief valves as check valves or control valves without carefully checking mfr. on each application.
6. Cleanliness is important in vessels, piping and valves. Leave flange covers and tags on until ready to install. Remove plastic plugs when ready to install.
7. Vent balanced bellows valves to atmosphere, in accordance with instructions on tag, even though flow from vents is normally zero.
8. Consult manuals.
9. Anchor piping.
10. Be sure test levers are down.
11. Reducing stations—refer to N. B. Boiler Inspection Code, 1952.
12. Tighten flange bolts 180° apart, progressively.
13. Do not damage flange faces.

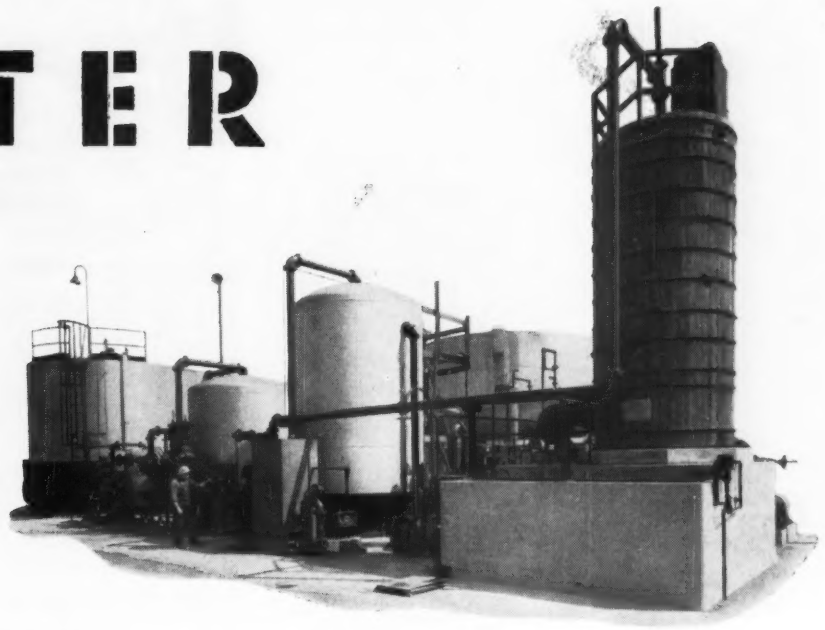
Maintenance and Inspection

It follows that maintenance problems are greatly diminished when full attention is given to the prior phases of selection, specification, and installation.

Too often, safety and relief valves are regarded as pipe fittings. Because of the similarity in external appearance, they are often improperly handled, stored, and repaired. A safer approach would be to classify this type of equipment as instruments; realizing that we are dealing with an automatic device which is self-actuated, depending on critical dimensions, concentricity, surface finish, corrosion resistance, and adjustment for good performance.

Maintenance and inspection procedures are quite detailed and vary with the manufacture. Therefore, each valve shop should be equipped with maintenance manuals for all types. Vital information covered is generally as follows: (1) part names and construction drawings, (2) valve operation, (3) handling, storage and installation, (4) test stand equipment and procedures, including blowdown ring settings, spring data, etc. (5) hydrostatic testing, test gages, (6) lapping equipment and compounds, (7) disassembly and assembly instructions, (8) common difficulties and solutions, (9) stocking and ordering spare parts, and (10) dimensions and/or gages for remachining seats.

WATER



. . . How It's Treated

Water impurities (last month's article) often demand treatment as discussed here. This article also goes into treating costs.

ESKEL NORDELL, The Permutit Co., New York

In last month's article we looked into the composition of water from various sources, and considered some of the purity requirements of the main industrial uses in process, cooling, boilers, and general service. In closing that article we took note of the main methods that are used for water conditioning, without describing what they are or how one goes about deciding which to use in a given case.

The best choice is often a difficult one, depending on the composition and quantity of water to be treated, as well as the requirements and tolerances inherent in the particular use. Usually it will be best to leave the final decision to a specialist, but for preliminary consideration, and approximate chemical requirements (see Table VI) and operating cost comparisons, the material given in this article should be helpful.

We have already noted that the main types of water-conditioning processes can be classed as (1) sodium cation exchange; (2) hydrogen cation exchange; (3) ion exchange demineralization using both cation and anion exchangers; (4) cold lime soda; (5) hot lime soda; (6) coagulation, settling and filtration; (7) aeration; (8) deaeration; and (9) iron and manganese removal processes. Actually, there are also many variations and combinations of some of these processes which may be used under certain circumstances.

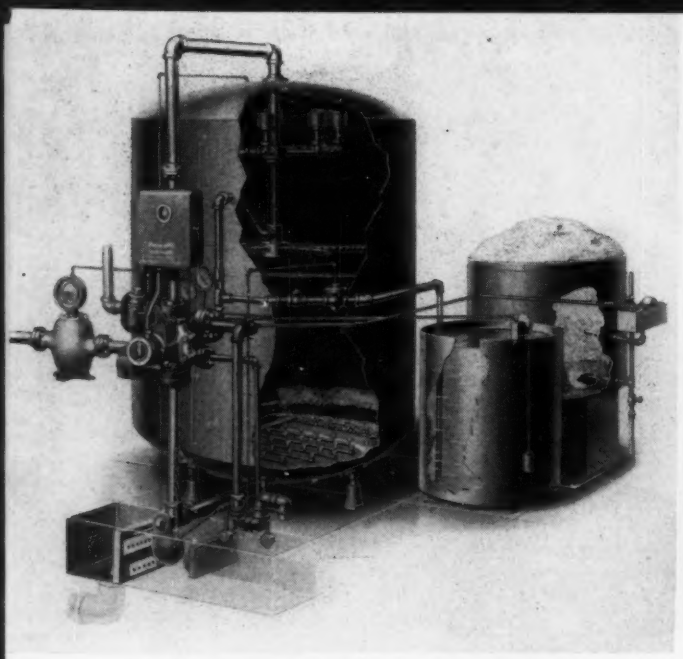
ESKEL NORDELL *is director of technical information of The Permutit Co. Author of many articles, he dealt with water impurities last month. Shown above is one type of ion exchange softener discussed here in which both hydrogen and sodium cation exchangers are used, with the effluents mixed.*

Sodium Cation Exchange

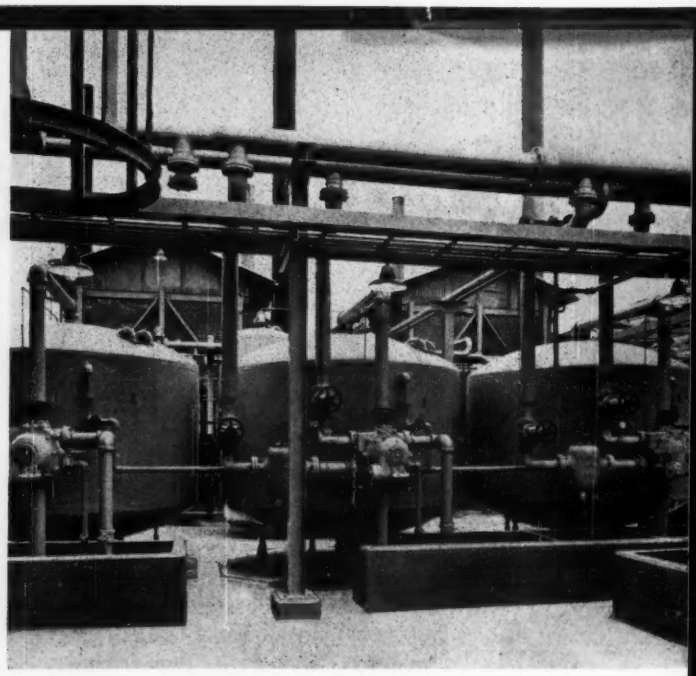
The sodium cation exchanger (or zeolite) water softening process may be carried out in either pressure or gravity type water softeners. With either, the principles of operation are the same so only the pressure type unit —which is almost universally used industrially—need be described. It consists of a closed steel shell designed to withstand whatever pressures will be encountered. It holds a bed, 24 to 96 in. in thickness, of a granular or bead type cation exchanger, supported by several layers of graded gravel. Under the bed is an underdrain or collector system as shown in Fig. 1.

Raw water is admitted to the upper portion of the shell and uniformly distributed over the surface of the cation exchanger bed, preferably through diffusers. Water flows downwardly through the bed and its calcium and magnesium ions are taken up and held by the zeolite. It in turn gives up an equivalent number of sodium ions to the water. At the end of the softening run—4 to 24 hr. in industrial practice—the unit is taken out of service and regenerated.

There are three steps to this regen-



SODIUM cation exchanger unit shows construction—(Fig. 1)



THESE sodium cation units soften 2,600,000 gpd.—(Fig. 2)

eration process. The first is backwashing, by passing a strong flow of water through the bed. This loosens and suspends the bed and washes to the drain any suspended insolubles which may have collected in the bed during the softening run. This backwashing operation, taking about 7 to 10 min., serves also to regrade the bed hydraulically.

The second step is salting, which introduces a predetermined amount of common salt solution into the softener by means of an hydraulic ejector. (Sometimes sea water is the regenerant.) This salt solution, diluted by the ejector water to about 10 to 15% NaCl, is distributed over the surface of the bed and evenly passed down through it. The salt reacts with the cation exchanger, removing the accumulated calcium and magnesium ions and replacing them with equivalent amounts of sodium ions. Thus the bed is restored to its original sodium state.

The summary of chemical requirements for water treating processes given in Table VI shows how to determine the salt needed for regeneration.

The third and last step is rinsing, to wash out the calcium and magnesium chlorides, plus the excess of salt, by means of a downward flow of the rinse water. After rinsing, the softener unit is returned to service ready to soften a further equal volume of hard water. Depending on the type of cation exchanger material employed, and the depth of the bed, total regeneration time may range from ¼ to 1½ hr. Sodium cation exchangers are usually supplied in batteries of two or more units, sized so that the other unit or units can handle the full load while one unit is being regenerated.

The four main types of sodium cation exchangers and their typical capacity ratings per cubic foot with different salt consumptions per kilograin are given in Table II.

In addition to removing calcium and magnesium ions, a sodium cation exchanger can also remove certain other ions. Of particular interest is its ability to remove soluble ferrous iron and manganous manganese. This property is frequently useful in softening hard iron and/or manganese bearing ground waters where these metals are almost invariably present as the soluble, divalent bicarbonates. When such waters are softened by the sodium cation exchanger process, the iron and/or manganese are removed simultaneously with the hardness. Also, when the cation exchanger is regenerated, these metals are taken out as the divalent chlorides simultaneously with the calcium and magnesium.

Sodium cation exchange is the most widely used of all water softening processes. This is largely due to excellent quality of the effluent—usually less than 2 ppm. in hardness—and the ease and simplicity of handling. The method also is widely used in combination with other processes such as the cold lime process, the hot lime process and the hydrogen cation exchanger process.

Hydrogen Cation Exchangers

The hydrogen cation exchanger process is carried out in acidproof equipment which may be closed for pressure, or open for gravity operation. The first of these is most widely used. The pressure type, shown to the left of the degasifier in Fig. 3, consists of a closed steel shell lined with an acid-proof material, usually rubber, and equipped with non-corrodible fittings. Its bed is 24 to 96 in. in depth, of a granular or bead type hydrogen cation exchanger. It is supported by several layers of graded gravel or Anthrafilt, lying over an underdrain or collector system.

Raw water is admitted to the upper portion of the shell and uniformly distributed over the surface of the bed. As the water flows down through the bed, calcium and magnesium, and also sodium, ions are removed from the water and held by the bed. The bed gives up to the water an equivalent amount of hydrogen ions in exchange. Certain other ions, among them iron and manganese, are removed simultaneously with the calcium, magnesium and sodium ions.

In the case of bicarbonates, this exchange reaction results in the formation of carbonic acid. This immediately breaks down into water and carbon dioxide which can very readily

be removed by aeration. Therefore it a water should contain nothing but bicarbonates, passing it through a hydrogen cation exchanger and then aerating it would result in a completely demineralized water containing nothing but a slight residual of carbon dioxide.

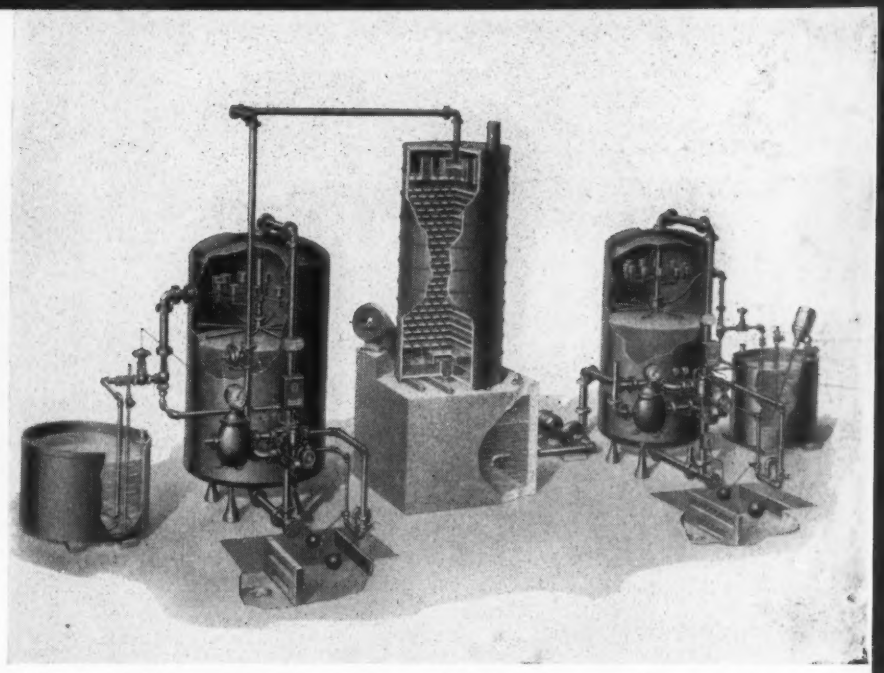
However, most waters, in addition to their content of bicarbonates, also contain appreciable amounts of sulfates and chlorides. During their passage through the hydrogen cation exchanger bed, these anions are transformed into corresponding amounts of sulfuric and hydrochloric acids. Usually these acids will have to be either neutralized or removed.

Neutralization can be effected with an alkali such as caustic soda or soda ash. But it can also be accomplished with the effluent of a sodium cation exchanger. The 2 million gpd. plant shown in the frontispiece is of this type, using seawater regeneration for the sodium cation exchanger. In the first case, caustic soda is usually employed and the hookup most widely used consists of a series of (1) the hydrogen cation exchanger unit, or units; (2) a forced draft degasifier; (3) a catch basin; and (4) an alkali feeder.

For the second type of neutralization, the hydrogen cation exchanger is operated in parallel with the sodium cation exchanger and the two effluents are mixed in such proportions that the sodium bicarbonate content of the latter will neutralize the acidity of the former, also furnishing whatever excess of alkalinity is desired. The hookup used consists of (1) the hydrogen cation exchanger unit, or units; (2) the sodium cation exchanger unit or units; (3) a forced draft degasifier; and (4) a catch basin.

Instead of neutralizing the acids, they may be removed with an anion exchanger. This process is described later in the section on ion exchange demineralization.

At the end of the operating run, which may be from 4 to over 24 hr., the unit is cut out of service and regenerated. There are three steps to the regeneration. The first step is backwashing, as with the sodium cation exchanger. This is followed by the regeneration step which consists in treating the bed with an acid to remove the accumulated cations of calcium, magnesium, and sodium, plus any other cations which have been abstracted from the water during the operating run. The acid may be either sulfuric or hydrochloric. Due to its lower operating costs, the first is most widely used.



ION-EXCHANGE demineralization plant uses both cation and anion exchange—(Fig. 3)

However H_2SO_4 forms sulfates with the metallic cations and one of these —calcium sulfate—has a rather limited solubility. It is necessary, therefore, to carry out the treatment so that the bed will not become fouled with precipitated calcium sulfate. One method of doing this is to dilute the incoming acid to 2%. With the high capacity resin type of cation exchanger, this does not fully regenerate it and it must be operated at a lower capacity than can be obtained with regeneration with a stronger solution.

Another method is to start the regeneration with 2% acid and then increase the strength in two or more steps so that the final strength is about 10%. This permits operation at a much higher capacity. If hydrochloric is used, 10 to 15% acid can be used right from the start since all of the chlorides formed are extremely soluble. On this account, where operating costs are not a prominent factor, hydrochloric acid is often used. With the carbonaceous type of cation exchanger, full capacity is obtained by regeneration with the 2% acid.

The third step of the regeneration is rinsing the bed free from salts and excess acid, after which it is returned to service. The total time required for regeneration ranges from 1¼ to 2 hr.

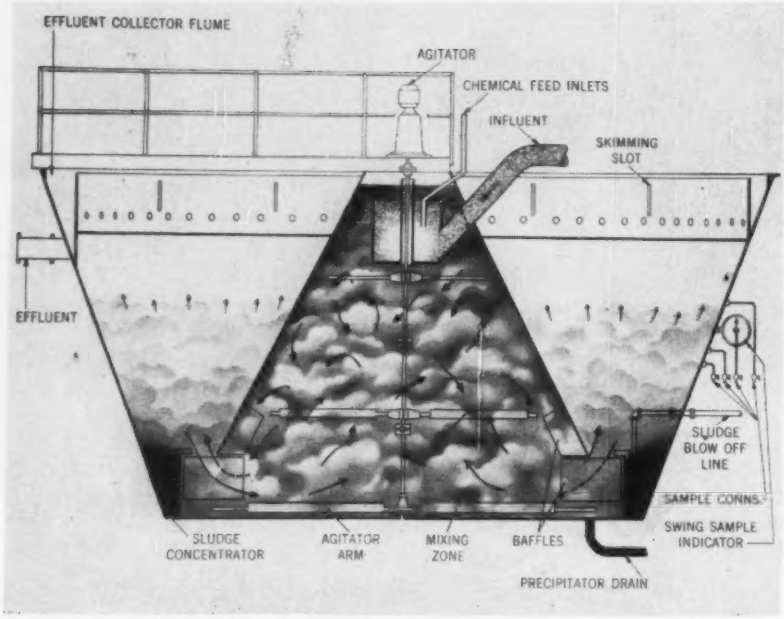
Neutralization of hydrogen cation effluent with an alkali is usually employed either when the free mineral acidity of the effluent is low or when the quantity of water to be treated is not very large. It is usually much more economical to use both sodium and hydrogen cation units and mix their effluents.

Ion Exchange Demineralization

In the ion exchange demineralization process, metallic cations are removed from the water in a hydrogen cation exchanger and anions are removed in an anion exchanger. The hydrogen cation exchanger is as previously described.

Two types of anion exchangers are used: (1) strongly basic, and (2) weakly basic. The first type removes strongly ionized acids such as sulfuric and hydrochloric and also weakly ionized acids such as carbonic and silicic. Such exchangers are regenerated with a solution of caustic soda. Weakly basic anion exchangers remove only strongly ionized acids. They may be regenerated with a solution of soda ash.

With the strongly basic anion exchanger, several hookups of the equipment are employed: (1) a two-step series of cation and anion exchangers, with a degasifier similar to Fig. 3;



MOST MODERN cold lime soda softener is the sludge blanket type–(Fig. 4)

(2) a two-step process without a degasifier; (3) four steps with a degasifier; (4) a mixed-bed unit; and (5) a hydrogen cation exchanger, plus a mixed bed and a degasifier.

While this sounds rather complicated, the basic reasons for this variety of hookups are very simple. First, it is cheaper to remove mechanically, rather than chemically, the carbon dioxide which is formed from the bicarbonates on passing through the hydrogen cation exchanger. Hence, the operating costs for the hookups using a degasifier, i.e., processes (1) (3) and (5), are less than those without a degasifier, i.e., processes (2) and (4).

Second, in one pass through a hydrogen cation exchanger there is a tendency with some waters toward a slight cation slippage. This means not entirely complete removal of all of the cations – particularly sodium ions–from sodium chloride or sulfate. Therefore, very complete demineralization calls for a two-pass arrangement such as process (3), or a mixed bed (process 4), or cation exchanger-mixed bed combination (process 5). It should be noted that a mixed bed, in effect, gives an extremely large number of passes.

A mixed bed unit is so-called because a mixture of cation and anion exchangers is used in a single shell. They are mixed by blowing air through them before an operating run. After the run they are separated hydraulically by a controlled backwash, so that the two materials can be regenerated separately. During regeneration the lighter anion exchanger lies on top of the heavier cation exchanger.

With a weakly basic anion exchanger, the usual hookup consists of a hydrogen cation exchanger and a weakly basic anion exchanger followed by a degasifier or, in the smaller sizes, a decarbonation tank.

Operating runs on anion exchangers may range from 10 to over 24 hr. Regeneration periods will range from 1½ to 3 hr.

Cold Chemical Processes

This group, so-called to distinguish it from the group of chemical precipitation processes which are operated at approximate boiling-point temperatures, includes (1) the cold lime, (2) cold lime soda, and (3) the two-stage cold lime and sodium cation exchange softening processes.

These processes use lime, which may be either chemical lime or hydrated lime. However, if the former, it must be slaked before introduction to the process. As in Table I, the lime reacts with free CO_2 present and with calcium bicarbonate to form the relatively insoluble $CaCO_3$ (solubility, 0.9 gpg.). If magnesium is to be removed, the lime precipitates it as the hydroxide (solubility, 1.0 gpg.). If non-carbonate hardness is present and is to be removed, soda ash also must be used. Such hardness consists of the sulfates or chlorides of calcium or magnesium. Soda ash reacts with calcium non-carbonate hardness to precipitate it as the carbonate. Magnesium non-carbonate hardness requires both lime and soda ash to precipitate it as magnesium hydroxide.

In these processes the resulting precipitates of $CaCO_3$, or $CaCO_3$ and $Mg(OH)_2$, are extremely finely divided as the consequence of the cold reac-

Table I—Principal Reactions of Chemical Processes

Free Carbon Dioxide with Hydrated Lime

$$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$$

Calcium Alkalinity with Hydrated Lime

$$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$$

Magnesium Alkalinity with Hydrated Lime

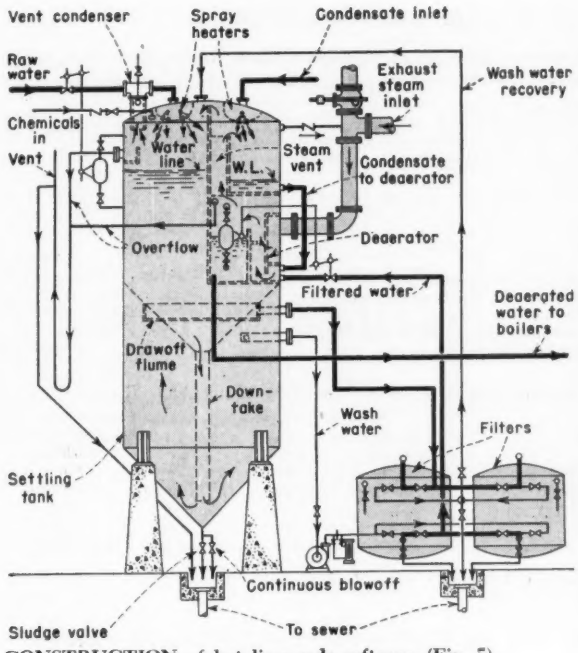
$$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow Mg(OH)_2 + 2CaCO_3 + 2H_2O$$

Calcium Noncarbonate Hardness with Soda Ash

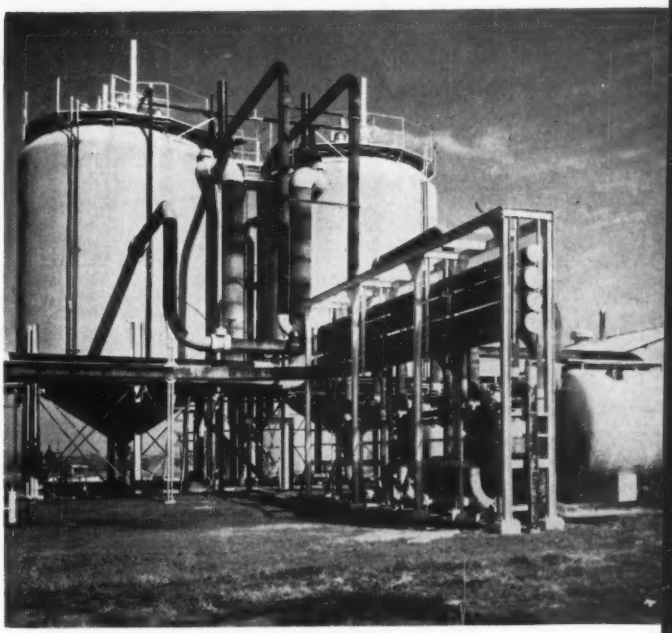
$$Ca\begin{Bmatrix}SO_4\\Cl_2\\(NO_3)_2\end{Bmatrix} + Na_2CO_3 \rightarrow CaCO_3 + Na_2\begin{Bmatrix}SO_4\\Cl_2\\(NO_3)_2\end{Bmatrix}$$

Magnesium Noncarbonate Hardness with Soda Ash and Hydrated Lime

$$Mg\begin{Bmatrix}SO_4\\Cl_2\\(NO_3)_2\end{Bmatrix} + Na_2CO_3 + Ca(OH)_2 \rightarrow Mg(OH)_2 + CaCO_3 + Na_2\begin{Bmatrix}SO_4\\Cl_2\\(NO_3)_2\end{Bmatrix}$$



CONSTRUCTION of hot lime soda softener—(Fig. 5)



HOT-PROCESS units soften sulfur mining water—(Fig. 6)

tion. It is necessary, therefore, to use a coagulant, such as aluminum sulfate, to form a large and easily settled floc. Usually the lime and the soda ash are fed together, while the coagulant is handled by a separate feeder.

The cold lime soda water softener was the first softening method. It was carried out initially as a batch process, later semi-continuously in three tanks. Still later, true continuous methods were developed, leading finally to the sludge blanket type shown in Fig. 4. In this, the raw water enters at the top of the inner compartment where a dosage of chemicals, proportioned to the fixed or varying water flow rate, is added and mixed with the water.

Emerging through ports at the bottom of this compartment, the treated water filters upward through a suspended blanket of previously formed sludge in the outer compartment. As the cross-sectional area of this outer compartment increases toward the top, the vertical velocity of the upflowing water gradually decreases until it reaches a plane at which it is no longer able to suspend the sludge. In practice, this forms a clear plane of demarkation between the undulating blanket of sludge and the relatively clear water above it. The height of this blanket is kept within certain limits by bleeding off old sludge at the same rate at which new sludge is being formed.

For many purposes, it is possible to use this effluent without further filtration, since its turbidity is usually well below 10 ppm. However, for uses where a perfectly clear effluent is required, or for removal of color from high-color waters, the effluent must be filtered before use.

Without any excess of chemicals, cold lime treatment alone may be used to reduce either the calcium alkalinity, or both calcium and magnesium alkalinities; (2) the cold lime soda process may be used to reduce both carbonate hardness and non-carbonate hardness; and (3) the two-stage cold lime and sodium cation exchanger process may be used to soften the water to practically zero hardness, reducing the total solids and alkalinity by the amount of carbonate hardness removed in the first stage.

The cold lime process, without excess chemicals, can remove calcium alkalinity to a minimum of not more than 35 ppm. If it is present, magnesium alkalinity can be reduced if necessary to a minimum of not over 33 ppm. These are manufacturer's guaranteed figures and actual reductions will be to slightly lower figures.

The cold lime soda process, without excess chemicals, will reduce the total carbonate and non-carbonate hardness to any desired degree down to the minimums mentioned for the cold lime process.

The two-stage cold lime and sodium cation exchanger process will reduce the total hardness to practically zero.

In general, the lowest cost for hardness removal is that for removing calcium alkalinity with lime. If the relative cost of this is taken as 1.0, then the removal cost for magnesium alkalinity with lime is 2.0, the removal cost for calcium non-carbonate hardness with soda ash is 5.0, and the removal cost for magnesium non-carbonate hardness with soda ash and lime is 6.0. These comparisons are based on using chemical lime and soda ash.

The two-stage cold lime and sodium cation exchanger process has several advantages over the cold lime soda process. (1) It removes a large part of the carbonate hardness with lime which is cheaper then removing it by cation exchange. (2) It removes the non-carbonate hardness by cation exchange which is much cheaper than removing it with soda ash and lime. (3) It reduces the total solids by an

amount equivalent to the carbonate hardness removed by the lime. Finally (4) it furnishes an effluent which is, for all practical purposes, zero in hardness.

Hot Chemical Processes

There are three hot water-softening processes: (1) the hot lime soda process; (2) the two-stage hot lime soda and phosphate process; and (3) the two-stage hot lime soda and sodium cation exchanger process.

These processes are all carried out at or slightly above 212°F. At these temperatures, free carbon dioxide is removed in the primary heater and vented to the atmosphere. Unlike the cold lime water softening processes, therefore, no dosage of lime is required for removing it. Neither is any coagulant needed because the precipitates formed are coarser and the water is less viscous than in the cold processes. Also, if the raw water contains any dissolved air, this will be removed in the primary heater to such an extent that the dissolved oxygen content will be reduced to less than 0.3 ml./l., which is sufficient deaeration for boilers operating at pressures under 250 psig. and without steel tube economizers. For boilers operating at higher pressures—or equipped with steel tube economizers—either an integral deaerator or a separate deaerator is used to reduce the dissolved oxygen to less than 0.005 ml./l. Owing to the high temperatures employed, use of these hot water softening processes is largely confined to the softening of boiler feed waters or those process waters which are to be used hot, for example, water for the Frasch sulfur mining process.

Data for Water Treatment Calculations

Table II—Typical Capacity Ratings of Sodium Cation Exchangers, With Corresponding Salt Consumptions

Exchanger Loading, Kgr. $CaCO_3$/Cu. Ft.				Salt Consumption.* Lb. NaCl/Kgr. as $CaCO_3$
High-Cap. Resin	Carbonaceous	White Synthetic	Greensand Standard	
20.0	...	....	...	0.275
22.0	...	....	...	0.3
25.0	...	8.0	2.5	0.4
26.0	7.0	9.0	2.8	0.45
27.0	...	10.0	3.0	0.5

* For high capacity resin, salt consumptions based on compensated hardness are as given for total cation contents ranging to 2 000 ppm. For the three other cation exchangers, additional amounts of salt are required for total cation contents over 500 ppm. Up to 1,300 ppm., these additional amounts of salt per kgr. of compensated hardness are: 500–599, 0.02 lb.; 600–699, 0.03 lb.; 700–799, 0.04 lb.; 800–899, 0.5 lb.; 900 to 1,099, 0.6 lb.; 1,100–1,300, 0.07 lb.

Table III—Coagulant Dosages and Effects on Raw Water Analysis

Raw Water Constituents Affected by Coagulants	Raw Water Analysis Corrections Due to Addition of Coagulant at Indicated Dosage*			
	Aluminum Sulfate (20 ppm.)	Ferrous Sulfate (20 ppm.)	Ferric Sulfate (10 ppm.)	Sodium Aluminate (10 ppm.)
Free carbon dioxide (ppm. CO_2)	+8	+6	+6	−6
Alkalinity (ppm. $CaCO_3$)	−9	−7	−6	+6
Sulfates (ppm. $CaCO_3$)	+9	+7	+6	None

* These dosages usually employed. Various coagulants increase or decrease the raw water constituents by number of ppm. shown.

Table IV—Lime and Soda Ash Requirements for Cold Chemical Processes

Constituent to Be Removed	Lb./Ppm. of Dissolved Constituent to Treat 1,000 Gal. Raw Water*		
	Hydrated (or) Lime 93% $Ca(OH)_2$	Chemical Lime 90% CaO	Soda Ash 98% Na_2CO_3
Carbon dioxide (ppm. CO_2)	0.0151	0.0118	None
Calcium alkalinity (ppm. $CaCO_3$)	0.00663	0.00519	None
Magnesium alkalinity (ppm. $CaCO_3$)	0.0133	0.0104	None
Calcium non-carbonate hardness (ppm. $CaCO_3$)	None	None	0.00901
Magnesium non-carbonate hardness (ppm. $CaCO_3$)	0.00663	0.00519	0.00901

* In waters containing sodium alkalinity, no lime dosage is needed for sodium alkalinity if calcium reduction alone is desired, or magnesium reduction below 80 ppm. is not needed. For further reduction of magnesium, add also 0.00663 lb. hydrated lime (0.00519 lb. chem. lime) for each ppm. sodium alkalinity expressed as ppm. $CaCO_3$.

Table V—Monosodium Phosphate Dosages for Hot-Process Boiler Waters

Volume Concentration in Boiler	Lb. Anhy. Monosodium Phosphate/1,000 Gal.		
	Process A*	Process B*	Process C*
5:1	0.21	0.28	0.10
6:1	0.19	0.26	0.08
7:1	0.18	0.25	0.07
8:1	0.17	0.24	0.06
10:1	0.16	0.23	0.05
15:1	0.15	0.22	0.04
20:1	0.14	0.21	0.03
40:1	0.13	0.22	0.0

* Process A is hot lime soda; Process B is two-stage hot lime soda and phosphate; Process C is two-stage hot lime soda and sodium cation exchange.

Hot Lime Soda

In the hot lime soda process, the water is first heated to temperatures around the boiling point. It is then treated with the required dosages of hydrated lime and soda ash and settled. Finally, it is filtered. All these operations are carried out continuously and at whatever flow rates are needed to meet the load requirements. The hydrated lime and soda ash react with the hardness to precipitate the calcium and magnesium content of the raw water, plus the added lime itself, which goes down as $CaCO_3$. The resulting sludge consists of calcium carbonate and magnesium hydroxide. As these have some slight solubility, there is a little residual hardness in the effluent. With the usual excess of soda ash—25 ppm.—the residual hardness of the filtered effluent is 20 ppm.

The total solids content of most waters is reduced by the hot lime soda process. Furthermore if the magnesium content is appreciable, the silica content will also be reduced. With an excess soda ash dosage of 25 ppm. the reduction in total solids—if everything except silica is expressed as ppm. calcium carbonate equivalents—is the (total carbonate hardness

Table VI–Chemical Requirements for Water Treatment

General—For calculations in this table, initial figures should be in ppm. as $CaCO_3$ equivalents. If expressed as ions, use factors as follows: (A) calcium hardness = Ca as $CaCO_3$ (Ca × 2.50); (B) Magnesium hardness = Mg as $CaCO_3$ (Mg × 4.12); (C) Sodium = Na as $CaCO_3$ (Na × 2.17); (D) Sulfates = SO_4 as $CaCO_3$ (SO_4 × 1.04); (E) Chlorides = Cl as $CaCO_3$ (Cl × 1.41); (F) Alkalinity = HCO_3 as $CaCO_3$ (HCO_3 × 0.82); (G) Carbon dioxide = CO_2 as $CaCO_3$ (CO_2 × 1.14) in anion exchange calculations, but in cold chemical process, express as CO_2; (H) Silica = SiO_2 as $CaCO_3$ (SiO_2 × 0.83). Then Total Hardness = A + B; Total Cations = A + B + C; Free Mineral Acidity = D + E. Also, 1 ppm. = 0.0583 gpg.; 1gpg. = 17.1 ppm = 0.143 lb./M gal.

A. Sodium Cation Exchanger Regeneration

Salt needed depends on (1) "compensated hardness" of raw water; (2) type of cation exchanger used; (3) degree of loading of the exchanger.

1. "Compensated hardness" is same as actual hardness if total hardness ≦ 400 ppm. or Na salts ≦ 100 ppm. If higher:

Compensated hardness in gpg.

$$= \frac{\text{total hardness, ppm.}}{17.1} \times \frac{9{,}000}{9{,}000 - TC^*}$$

* TC = total cations = Ca + Mg + Na etc. in ppm. as $CaCO_3$.

1a. Express compensated hardness as next higher 0.1 gr. up to 5 gpg.; next higher 0.5 gr. up to 10 gpg.; next higher grain above 10 gpg.

2, 3. From Table II find loading of particular exchanger used and salt consumption rate for that loading. Then:

Compensated hardness, in gpg. × lb. salt rate, lb./kgr. = salt, lb./1,000 gal.

B. Hydrogen Cation Exchanger Regeneration

Consumption of 66° Bé. sulfuric in resin cation exchangers ranges from 0.45 to 0.55 lb./kgr. Carbonaceous exchangers take 0.25 to 0.35 lb./kgr. on suitable waters with ratios of total alkalinity to (SO_4 + Cl) ≧ 1. HCl consumption in resin exchangers is 0.225–0.333 lb. 100% HCl/kgr. Then, total cations (Ca + Mg + Na) in gpg. × lb. acid/kgr. = acid, lb./1,000 gal.

C. Hydrogen Cation Exchanger Effluent Neutralization

1. Using NaOH
[(SO_4 + Cl + req. alkalinity, ppm.)/17.1] × 0.117 = lb. 98% NaOH/1,000
2. Using mixture of Na-cation and H-cation exchanger effluents
Fraction of 1,000 gal. from H-cation exchanger effluent

$$= \frac{(\text{Alkalinity})_{raw} - (\text{Alkalinity})_{req.}}{(\text{Alkalinity})_{raw} + FMA^*}$$

* FMA (free mineral acid in H-cation effluent) = (SO_4 + Cl in ppm.

D. Hydrogen Cation Exchanger With Strongly Basic Anion Exchanger

1. Acid for H-cation exchanger
Calculate as in section B.
2. NaOH for anion exchanger, with degasifier
[(SO_4 + Cl + Resid. CO_2 + SiO_2 ppm.)/17.1] × F* = lb. 98% NaOH/1,000 gal.

* F is 0.321 if used warm; or 0.428 if used cold.

2a. If no degasifier is used, add (Total alkalinity/17.1) × F*

E. Hydrogen Cation Exchanger and Weakly Basic Anion Exchanger

1. Acid for H-cation exchanger
Calculate as in section B.
2. Soda ash for anion exchanger
[(SO_4 + Cl × 1.33 ppm.)/17.1]gpg. × 0.221 = lb. 98% Na_2CO_3/1,000 gal.

F. Cold Chemical Processes

Chemical requirements vary widely depending on composition and hardness reduction required. Detailed figures cannot be given for all requirements, but the following notes will help in reaching approximate dosages for various conditions.

1. These processes require a coagulant which in effect alters the raw water composition as in Table III. Raw composition should therefore first be corrected by use of Table III. Coagulant dosage affects free CO_2 (expressed as CO_2), total alkalinity (and sulfates).
2. Enough lime must be used to precipitate the free CO_2, unless aeration is used, in which case, add lime for free CO_2 residual.
3. If lime addition is limited to precipitate only the calcium, about 10% of Mg will also come down, so enough lime must be added for this.
4. Any Mg non-carbonate hardness precipitated with lime will leave an equivalent amount of Ca non-carbonate hardness in solution.
5. Table IV gives dosages per 1,000 gal. treated, as lime or soda needed for each ppm. of CO_2 (as CO_2), calcium and magnesium alkalinity, and non-carbonate hardness (as $CaCO_3$).

G. Hot Chemical Processes

1. Lime requirement
(Alkalinity + Mg hardness, ppm.)/F* = lb. lime/1,000 gal.

* For hydrated lime, 93% $Ca(OH)_2$, F = 151; for chemical lime, 90% CaO, F = 193.

2. Soda ash requirement
[(Total hardness − alkalinity, ppm.)/111] + 0.21 = lb. Na_2CO_3/1,000 gal.
3. Monosodium phosphate is usually added in boiler drums equivalent to 40 ppm. as PO_4. Amount added depends on both residual hardness and on volume concentration in boiler. See Table V for amounts to be added per 1,000 gal., choosing proper column for the particular softening process.
4. For salt requirements of hot lime sodium cation process, use section A above, basing gpg. of hardness on non-carbonate hardness of raw water, plus gpg. residual carbonate hardness.

H. Iron and Manganese Removal by Cation Exchangers

Small amount of salt or acid to be added for Fe or Mn removal is calculated by section A or B, after converting Fe and Mn to equivalent gpg. as $CaCO_3$.

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minus 45 ppm.) + ppm. of silica removed. If there is insufficient magnesium in the raw water to reduce the silica content to the required residual, then dolomitic lime or activated magnesia may be used to make up the deficiency.

The equipment used when complete deaeration is required is shown in Figs. 5 and 6. It usually consists of five elements including: (1) the primary heater; (2) chemical feeders; (3) a settling tank; (4) a deaerating heater; and (5) two or more filters. With this hookup the dissolved oxygen will be reduced to less than 0.005 ml./l. If such a degree of deaeration is not required, the fourth element–the deaerating heater–may be omitted.

Exhaust steam is employed to heat the raw water. When a deaerating heater is used, all of the steam is first passed through it before it enters the primary heater. In the primary heater, the raw water is sprayed down through the steam which heats it close to the boiling point and drives out the free carbon dioxide and also any dissolved air that is present.

These liberated gases are removed, usually through a vent condenser, and scavenged to the atmosphere by a small plume of steam.

As this hot water falls into the upper level of the water in the softener, it is mixed with measured dosages of the chemicals which react with the hardness and precipitate it as quickly settling sludge. This collects in the bottom of the settling tank for removal to waste by either a manually or automatically operated desludging valve. In the sludge blanket type of equipment, which is particularly efficient in removing silica, the downcomer for the treated water extends almost to the bottom of the settling tank, so that the water is filtered upwards through a blanket of suspended sludge. In other designs, the downcomer ends above the upper level of the sludge.

In either type, the flow of the water is first downward to a designated level, at which the flow is reversed. Then it rises to the drawoff from which it passes to the deaerator, and from there to the filters. The filters are of the closed pressure type and are filled with a non-siliceous filter medium such as Anthrafilt (crushed and graded anthracite) so as to eliminate any silica pickup by the hot alkaline effluent. Backwashing of the filter units is accomplished with hot, softened water from the settling tank and this backwash water is recovered by recirculating it back to the settling tank. The filters are supplied in batteries of two or more units so that when one unit is being backwashed, the other unit or units will carry the full load, thus assuring uninterrupted service.

Hot Lime Soda and Phosphate

In the two-stage hot lime soda and phosphate process, the effluent from the hot lime soda settling tank is treated without prior filtration with sodium phosphate in either a separate settling tank or a compartment. The phosphate reacts with the residual hardness (soluble plus a small content of suspended precipitate) to precipitate it as the extremely insoluble calcium phosphate. The filtered effluent has a practically negligible amount of total hardness, about 2 ppm.

The hookup employed consists of the hot lime soda unit plus two additional elements, a phosphate feeder and a phosphate settling compartment or separate settling tank. Although the effluents from both processes are practically zero in hardness, the two-stage hot lime soda and phosphate process is being largely replaced by the two-stage hot lime and sodium cation exchanger process because of its lower operating costs and lower alkalinity and total solids in the effluent.

Hot Lime and Cation Exchange

In the two-stage hot lime and sodium cation exchanger process, the usual hookup consists of: (1) the primary heater; (2) the chemical feeders; (3) the settling tank; (4) the filters; (5) the sodium cation exchangers; and (6) the deaerating heater.

As it is more economical to remove non-carbonate hardness by the sodium cation exchanger process than by precipitating it with soda ash, the addition of soda ash in the first step of this process is usually omitted and only hydrated lime is added. Depending on the composition of the water and specifications for the silica content of the effluent, it may be advisable to use some dolomitic lime or activated magnesia and to precipitate the entire magnesia content of the raw water. With any non-carbonate magnesium hardness, this results in precipitating the great bulk of the magnesium; but, since an equivalent amount of calcium non-carbonate hardness is formed, there is not any reduction in the total non-carbonate hardness.

The effluent from the first stage of this process is then filtered and passed through the sodium cation exchangers which remove both the non-carbonate and residual carbonate hardness and give an effluent of practically zero hardness. The advantages of this two-stage hot lime and sodium cation exchanger process are that it reduces the alkalinity, total solids and silica content; that it produces an effluent which is practically zero in hardness; that with the primary heater alone, it deaerates the water to less than 0.3 ml./l. When the sodium cation exchangers are followed by a deaerating heater, it deaerates to less than 0.005 ml./l. By using lime for the carbonate hardness and ion exchange for the non-carbonate hardness, it offers very economical operating costs.

Coagulation, Settling and Filtration

Turbidity, color and most chelated iron and/or manganese, may be removed or reduced to allowable tolerances by coagulation, settling and filtration. If the raw water also contains large amounts of coarse sediment, sedimentation is often of value for removal of the sediment before coagulation. This may be accomplished in reservoirs or sedimentation tanks or basins. The detention period required is best determined from on-the-spot tests. This may vary from several hours with tanks and basins, up to several days, weeks or months in reservoirs.

Sedimentation alone usually accomplishes only a partial removal of turbidity. Any color is usually only partially bleached, even after relatively long exposures to sunlight in fairly shallow reservoirs. Satisfactory removal of these and other suspended matter may be accomplished by coagulation, settling and filtration. These clarification processes also effect a great reduction in microorganisms, while chlorination eliminates them.

Coagulation involves adding an aluminum or iron coagulant to the water. This reacts with the natural or added alkalinity of the water to produce a gelatinous precipitate which, by cataphoresis and simple entanglement, adsorbs or enmeshes the turbidity and color, producing larger aggregates ("floc"), which may then be removed by settling and filtration.

The most widely used coagulant is aluminum sulfate, commonly though erroneously called "filter alum." Other coagulants include aluminum chloride, ferric sulfate, ferrous sulfate, "chlorinated copperas," and sodium aluminate. When ferrous salts are employed, they must be oxidized, either by air or by some other oxidizing agent, to the ferric form in order to ensure their complete removal.

For efficient coagulation, it is

necessary to maintain the pH value of the water within a certain range. Broadly, aluminum sulfate coagulates well between pH values ranging from about 5 to 7. The optimum pH value for each surface water supply is best determined locally. The waters that coagulate most readily are those which consistently show an appreciable amount of turbidity and also contain appreciable amounts of dissolved mineral matter. Waters which are high in color and low in turbidity and dissolved mineral matter are the ones which are most difficult to coagulate.

Settling tanks are employed for two purposes: first, to provide a sufficient detention period to allow coagulation reactions to go to completion with the formation of a large, tough floc; and second, to settle out the bulk of the floc, thus relieving the load on the filters and permitting much longer filtration runs between backwashings. The sludge blanket type, in which the treated water is filtered upwardly through a suspended blanket of previously formed sludge, is the most modern type of settling equipment.

For some purposes, the effluent from such equipment is clear enough for use. In most cases, however, the effluent is filtered before use. Filters may be of either the gravity or pressure type. In both the principles of operation are much the same, with the water filtered downwardly through a layer of fine filter sand or Anthrafilt, supported on several graded layers of coarser material. At intervals, usually from 8 to over 24 hr., the accumulated material caught by the filter is removed by backwashing for about 10 min. The water is then filtered to waste for a few minutes and the filter unit then returned to service.

Chemical costs will vary greatly for different surface supplies. Coagulant dosages will range from 0.5 to over 5.0 gpg. (0.071 to 0.71 lb. per 1,000 gal.). If corrective chemicals are required for control of pH, these will increase coagulant costs from 50 to 100%. With some waters, clay will also be needed to insure formation of a good floc and increase the pH range over which good coagulation can be effected. Clay dosages may range from 1 to 3 gpg. (0.143 to 0.43 lb. per 1,000 gal.).

DOUBLE-unit deaerating heaters process 8,900,000 gpd. water for a refinery—(Fig. 7)

Chlorine requirements vary in quantity, and costs also depend on whether the liquefied gas or hypochlorite is used. As a rather rough estimate, chlorine costs when liquid chlorine is used may range from 0.03 c. to 0.2 c. per 1,000 gal. Costs will be from two to three times as much when a hypochlorite is used.

Aeration

Aeration is used for the removal of carbon dioxide, hydrogen sulfide, and methane, as well as tastes and odors from water. It is used also for the oxidation of divalent iron and manganese to their practically insoluble hydroxides. Aerators may be broadly divided into four types: (1) open; (2) forced-draft, countercurrent; (3) tank; and (4) pressure saturation type.

In various designs of the first class, the water is sprayed into the air, or rained down through the air over a series of riffles, shelves, wood slats, or layers of coke. In the second class, a blower forces air up through a tower while the water rains down over a series of slat trays or a packing of Raschig rings.

In the third, air from a blower is blown up through a depth of water in a tank. In the fourth class, a portion of the water (commonly one-quarter or less) is saturated under pressure with air from a compressor and this is then mixed with the rest of the water. This system is seldom used and then only for furnishing enough oxygen to oxidize the iron content of the water.

At 2 c. per kwh., pumping costs for open type aerators range roughly from 0.1 to 0.2 c. per 1,000 gal. In the forced-draft type, pumping and blower costs for reducing 35-400 ppm. of carbon dioxide down to 5-10 ppm. range from 0.25 to 0.35 c. per 1,000 gal. For the same amounts and degree of removal of carbon dioxide in

the tank type aerator, costs range from 1.0 to 3.0 c. per 1,000 gal. In pressure type aerators, costs for compressing the small amounts of air required range from 0.1 to 0.3 c. per 1,000 gal.

Deaeration and Corrosion Inhibiting

Deaeration of water may be effected hot in a deaerating heater (Fig. 7), or cold in a vacuum deaerator. In either case, the water is boiled. Its temperature will be slightly above 212°F. and its pressure slightly above atmospheric in the first case. In the second the water boils at ordinary temperatures, but in a high vacuum. At the boiling point, oxygen, nitrogen and carbon dioxide are insoluble, and the water vapor lowers the partial pressures of these noncondensible gases and scavenges them to the atmosphere.

In spray type and certain other designs of single-pass deaerating heaters, water may easily be deaerated to below 0.3 ml./l., which is sufficient for low pressure boilers and some other uses. High pressure boilers need a reduction to below 0.005 ml./l., which can be obtained by heating the water to the boiling point and then scrubbing it with steam. As the water requires heating before use anyway, the only heat wasted is that in a small plume of scavenging steam. Costs for this are around 0.1 to 0.2 c. per 1,000 gal. of water deaerated.

Steam jets are ordinarily used in vacuum deaerators to pull the vacuum, although in smaller sizes vacuum pumps are sometimes employed. The deaerator consists of a high cylindrical steel shell, fitted with a series of wood slat trays or packed with Raschig rings. Usually a deaeration to below 0.3 ml./l. is sufficient. Costs vary somewhat depending on the temperature of the cold water, but will range from about 0.5 to 1.3 c. per 1,000 gal. for steam and pumping costs. With vacuum pumps, costs are somewhat higher, ranging from about 1.5 to 2.0 c. per 1,000 gal.

Corrosion inhibiting in steam boilers is the function of sodium sulfite which is widely used to guard against the accidental introduction of dissolved oxygen. At boiler temperatures, sodium sulfite reacts rapidly with dissolved oxygen to form sodium sulfate. In cold water, this reaction is slow unless catalyzed with cobalt or copper. A relatively new application is the use of hydrazine as a deoxidant in boilers. For protection of return lines, both volatile and filming amines are being used.

For the protection of water piping, process lines, cooling jackets, and the like (but not boiler feed lines), caustic silicate is widely used. The amounts employed are usually about 0.1 lb. 40°Bé. silicate of soda (water glass) per 1,000 gal., plus enough caustic soda to raise the pH to about 8.3.

For mains, jackets, etc., where a small amount of hardness is not objectionable, the production of a slight film of calcium carbonate scale on the metal surfaces is of value. This is produced by treating the water, usually with hydrated lime, so that it will be slightly supersaturated with calcium carbonate at the temperatures encountered. This is then controlled by inserting removable sections or inserts at strategic spots, watching the results and adjusting the treatment accordingly.

Iron and Manganese Removal

In alkaline iron or manganese bearing waters from deep wells, the metals are present as the soluble and colorless divalent bicarbonates. The iron or manganese content of such waters can be removed by (1) aeration, settling and filtration; (2) cation exchange in either sodium or hydrogen cation exchangers; or (3) by filtration through a bed of manganese zeolite, provided not over 1 ppm. is present.

For removing iron by aeration, settling and filtration, pH values of 7.0 or over are sufficient to insure rapid oxidation. Manganese requires a much higher pH for rapid oxidation, slightly over 10.0. However, previously precipitated manganese will act as a catalyst so if "ripened" filters are used, the divalent manganese will be oxidized at pH values of 8.5 to 9.0 as the water passes through the filters. This presents the difficulty, though, of building up thicker and thicker deposits on the sand grains so that bits of the manganese deposits will later flake off and contaminate the effluent. This requires periodic removal of the coatings. Because of intimate contact of the water with previously formed precipitates, the sludge blanket type of equipment is especially efficient in removing both manganese and iron.

Operating costs vary according to the composition of the water and whether or not other treatment of the water is also required. For instance, if the water is to be treated by one of the cold lime processes, then the only cost is for aeration. On the credit side, the coagulating effect of the iron or manganese, plus removal of free carbon dioxide to a low residual, should be taken into account. If iron or manganese removal alone is required, then the operating costs are for aeration, as given above, plus a little pressure loss in the filters.

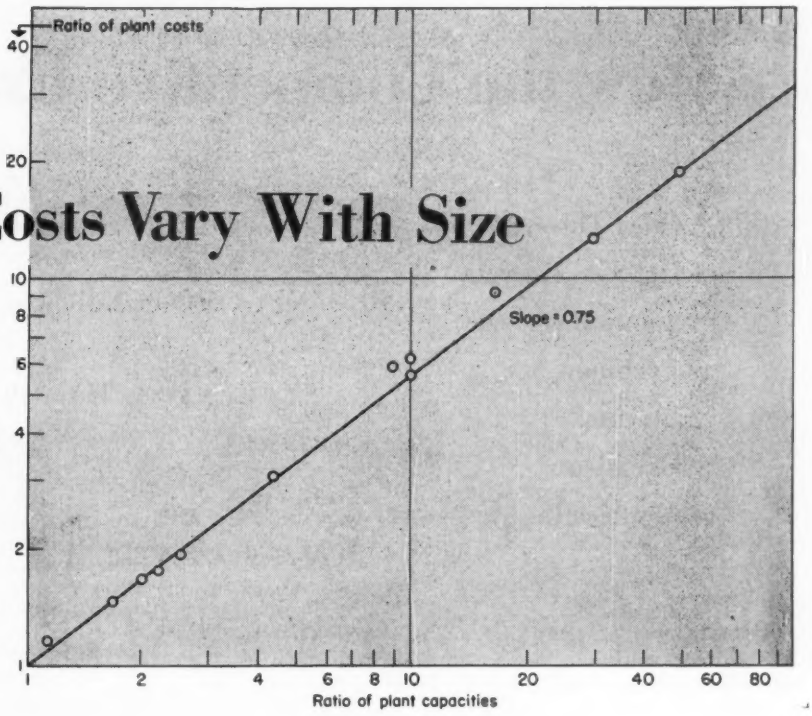
When iron or manganese bearing waters are softened by a cation exchanger operating on either the sodium or hydrogen cycle, these metals are removed together with other removable cations. On regeneration, they too are removed from the exchanger bed. As these metals are usually present only to the extent of a fraction of 1 gpg., they do not appreciably increase the operating costs.

In the manganese zeolite process, a filter bed of manganese zeolite is used both to oxidize the iron or manganese content to the insoluble hydrated oxides, and also to remove them by filtration. At intervals, the filter is backwashed to remove the accumulated insolubles. Then when the oxidizing capacity is practically exhausted, it is regenerated with a solution of potassium permanganate. As this is a rather expensive regenerant, this process is usually limited in industrial use to waters containing not more than 1 ppm. of iron or manganese, in cases where it is desirable to treat the water under pressure.

Capacity of a manganese zeolite bed is 0.09 lb. of iron or manganese per cu. ft. The amount of potassium permanganate required to regenerate it is 0.18 lb. per cu. ft. At usual prices for permanganate, the regenerant cost for removing 1 ppm. of iron as Fe, or 1 ppm. of manganese as Mn, from 1,000 gal. of water is approximately 0.4 c.

How Plant Costs Vary With Size

Cost-capacity data for electrolytic chlorine plants show how multiple-unit installations of cells and rectifiers influence over-all plant costs.



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ONE OF the most widely used rules of thumb for estimating investment costs is the "six-tenths factor."

This rule is used to estimate the cost of a piece of equipment when you know the cost of a similar unit of different size. If the unknown is x times the size of the known, then its cost is $x^{0.6}$ times the cost of the known item. If you plot cost vs. size on logarithmic coordinates, you get a line with a slope of 0.6.

Chlorine Cost-Capacity Data

Tons/Day	$, Thousands
Diaphragm cells	
44	2,000
50	2,330
	3,940*
130	10,000
220	12,500
Mercury cells	
5	431
	738*
11	765
50	2,720
	4,100*
100	4,630
Package mercury cell	
0.1	22.6
3	290

* Complete plant cost, including general facilities.

For most types of process equipment the rule works fairly well. What happens, however, when you are considering an entire plant?

Several years ago Chilton published (*Chem. Eng.*, Apr. 1950, pp. 112-4) a study of complete plant costs, in which he plotted plant costs in dollars against production capacities in tons per day for 36 different types of plants. Although the median slope for the 36 curves was 0.66, several curves had slopes between 0.88 and 1.0. Chilton explained that these curves represented plants which were composed predominantly of multiple units.

One type of plant not covered in Chilton's article is electrolytic chlorine-caustic soda. Roughly half the cost of a chlorine plant is the cost of the cell installation. Increased plant capacity is usually obtained by installing more cells, not by increasing their size. Thus the slope of a cost-capacity curve should approach 1.0.

On the other hand, the rest of the plant consists of equipment which you would normally expect to follow the 0.6 rule. So the total cost should vary with size by some factor about midway between 0.6 and 1.0.

To determine just what this factor might be, the writer has taken published data on chlorine plant costs, supplemented them with information acquired privately, and plotted the above graph. Slope of the line is 0.75.

As evident from the tabulation, the data are not altogether consistent. Chlorine plants may use diaphragm or mercury cells; they may use chlorine directly for making other products or liquefy it for sale; caustic may be produced in several different concentrations. Also, construction costs change over the years.

To avoid these inconsistencies, each point on the graph represents, not the cost and capacity of a single plant, but the ratio of two carefully selected plant costs and capacities. Selection of plants for comparison took into account the above factors which affect plant investment. In addition, the line was drawn with less weight given to points for which less confidence was felt in the basic data.

Good agreement is shown over a 50-fold ratio of capacities. Thus, if you knew the cost of a 5-ton-per-day plant, you could estimate the cost of a 220-ton plant of similar construction with good accuracy.

How the Competitive Urea Processes

- Once Through
- Hot Gas Recycle
- Solution Recycle
- Pechiney
- Inventa
- Chemico
- Montecatini

TECHNICALLY—Newer processes attempt to

ECONOMICALLY—On paper, Montecatini

IN RECENT months, activity among urea producers has reached an all-time high. Three new plants have started up in a little over a year and three more are due to go onstream before too long. In addition, a wide variety of chemical processes have become available and will be vying for greater attention in the future.

Here is a close look at how these competitive processes compare—both technically and economically.

Use Same Basic Reactions

In contrast to other groups of chemical processes which produce the same end product but start with different raw materials, all of the urea processes are simply modifications of the same basic reactions: One mol of carbon dioxide reacts with two mols of ammonia to yield ammonium carbamate. The carbamate then decomposes to form urea and water.

These reactions take place in either the liquid or solid state. Both are reversible, equilibrium depending on proper selection of temperature, pressure and concentration level. Higher temperatures improve the yield, but higher pressures are then required to keep the reactants from going to the gaseous state.

In addition, the disocciation pressure of the ammonium carbamate climbs sharply with temperature (1 atm. at 60° C.; 7 atm. at 100° C.). To keep the reaction going in the desired direction, the operating pressure must be kept greater than the corresponding dissociation pressure. Operating pressures in the 3,000 to 6,000 psi. range are commonly used.

Most processes maintain an excess of ammonia in the reaction autoclave to shift the equilibrium to favor production of the carbamate. The reaction is highly exothermic and must be closely controlled. Further, the reaction mix is extremely corrosive under the process conditions.

Must Remove Process Heat

The decomposition, or dehydration, of ammonium carbamate to urea is endothermic. However, net result of

• Once Through Process

Liquid ammonia and liquid carbon dioxide react at 320 to 390° F. and 1,750 to 3,000 psi. From the reaction autoclave, the mix goes to a stripper where part of the ammonium carbamate formed in the reaction rapidly decomposes to urea and water. Remaining carbamate dissociates into ammonia and carbon dioxide at the low pressure in the stripper. These gases are removed from the system. The urea solution goes to an evaporator.

FEATURES—Unconverted gases and NH_3 and CO_2 from the dissociation of the carbamate are not recycled. But for economic success, it's necessary to recover the NH_3 for use elsewhere. It is usually recovered as the sulfate or nitrate. Corrosion is severe and reaction equipment is usually lined with lead or silver.

• Hot Gas Recycle Process

After being compressed to 1,750 to 1,900 psi., liquid NH_3 and liquid CO_2 are cooled, then reacted at 320 to 340° F. Cooling must be done with care, since dropping the temperature too far limits the formation of ammonium carbamate. Liquid carbamate converts to urea and water and this is removed as bottoms from the stripper. Unreacted NH_3 and CO_2 gases are also taken off at the stripper. They are kept hot, recompressed and returned to the reactor.

FEATURES—Solid ammonium carbamate forms in the 5-stage gas compressors and tends to clog the lines. Corrosion also poses a severe processing problem. High investment requirements plus exorbitant operating and maintenance charges have outdated this process.

• Solution Recycle Process

Unconverted CO_2 and NH_3 from the reaction autoclave are recycled as an aqueous solution of ammonium carbamate. The recycle stream joins fresh CO_2 and fresh and recycle NH_3 at the autoclave and reacts at 390 to 410° F. under a pressure of 6,000 psi. The ammonium carbamate formed goes to an ammonia separator where unreacted NH_3 flashes off to be recompressed and recycled. Carbamate passes to the strippers which remove NH_3 and CO_2 from the aqueous urea solution product. These unconverted gases are absorbed in water and recycled.

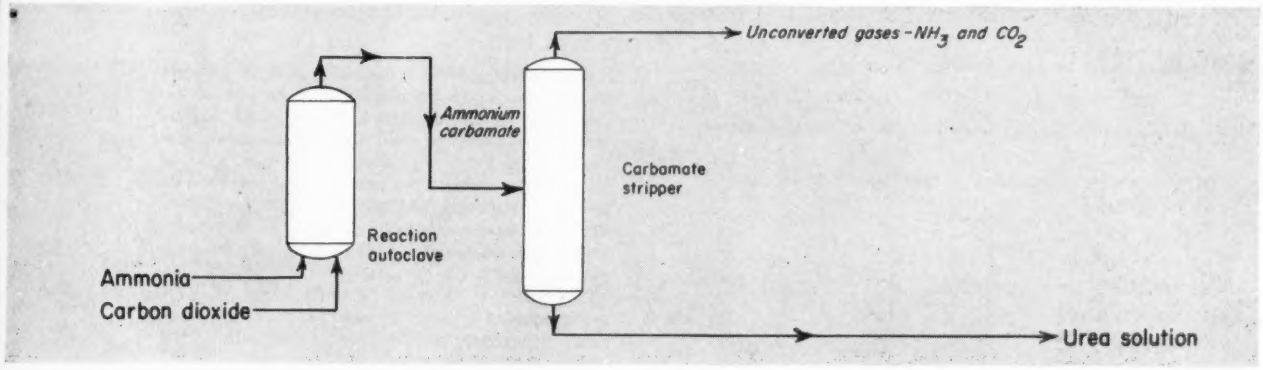
FEATURES—Water in the autoclave cuts conversion, but using an excess of 3 to 5 mols of NH_3, and extreme conditions of temperature and pressure keeps yield high. Corrosion is so severe that even silver-lined equipment is attacked. Costs are high.

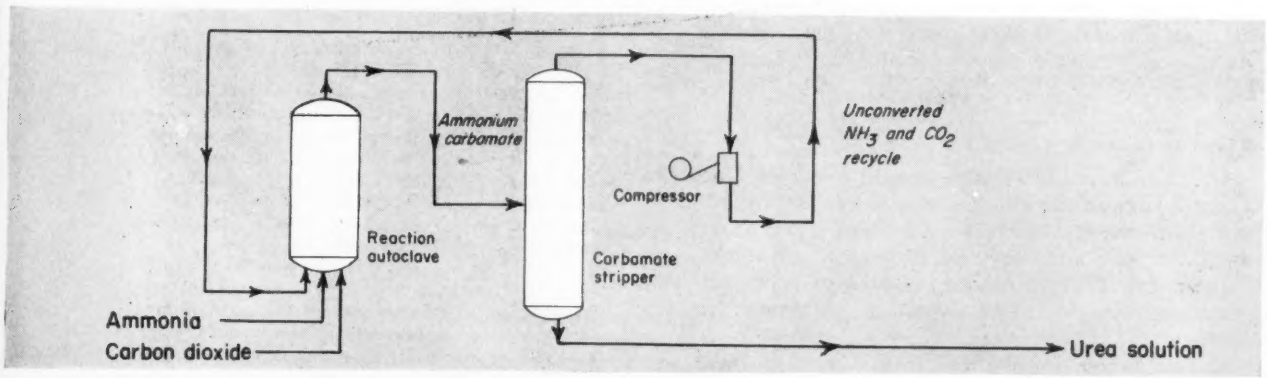
Compare Today

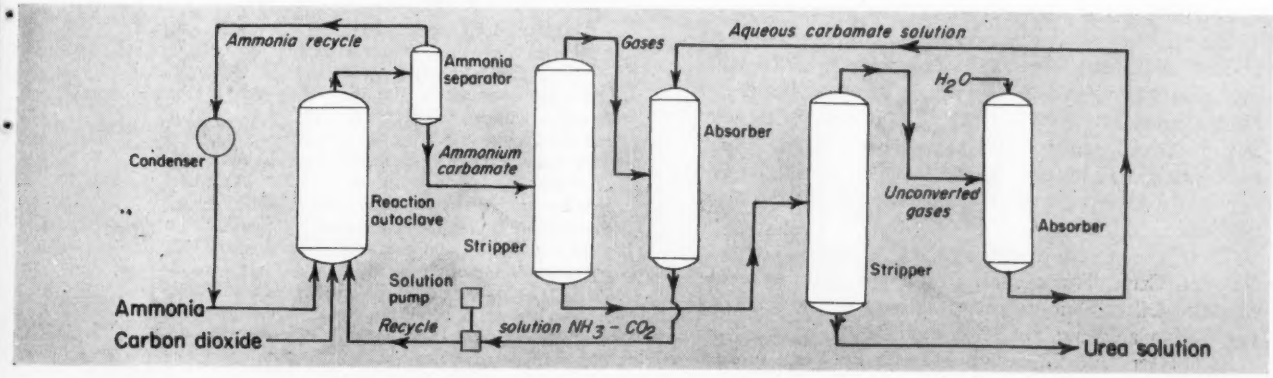
by WILLIAM H. TONN, Jr., Chemical Consultant

reduce the toll taken by corrosion and to boost the conversion per pass.

process looks best, but field conditions may give another the edge in a specific case.







the two reactions is exothermic and, consequently, provision must be made to dissipate the heat from the process.

Going from ammonium carbamate to urea is also a reversible reaction. Dropping the pressure—but still keeping it higher than the vapor pressure of urea-carbamate melt—shifts the equilibrium to favor urea production. In processing, the maximum conversion of ammonium carbamate to urea runs 40 to 50% per pass. Carbamate not converted to urea dissociates back to ammonia and carbon dioxide.

For a process to be competitive the unconverted gases must be recovered and either used elsewhere or recycled. Recycling appears to be the most attractive alternative and is used, in one form or another, in all but one of the various methods.

New Designs Aim to Lick Process Woes

All of the modifications of this basic procedure are attempts to lick operating difficulties and to boost efficiency and yields.

The various processes used commercially today are:

- Once through.
- Hot gas recycle.
- Solution recycle.
- Pechiney (oil slurry recycle).
- Inventa.
- Chemico.
- Montecatini.

The first two processes listed are the oldest, and until recently were considered obsolete. In new construction here, processes using the newer modifications have gotten the major emphasis. However, plants using these processes are still being constructed and operated throughout Europe and Asia.

Where It Comes From

Of the U. S. plants, Allied is reported to use the Once Through process along with its own improvements. Allied's two plants—one at South Point, Ohio with about 85,000 tons/yr. capacity and one at LaPlatte, Neb., which came onstream July 1954 with about 105,000 tons/yr. capacity —represent the greatest total capacity of any current urea producer.

DuPont, whose 150,000 tons/yr. installation at Belle, W. Va. is the oldest and largest in the country, uses the Solution Recycle process with improvements and modifications resulting from some 22 years of experience.

The activity of recent years has spurred the development of new modifications of the basic processes. All of the new plants—such as Deere's, which came onstream last November at Pryor, Okla., with 95,000 tons/yr. capacity and Grace Chemicals' Memphis, Tenn., plant, which added its 55,000 tons/yr. to the total U. S. capacity last February—use one of these modifications of the older methods.

Those plants now abuilding—Shell Chemical Corp. at Ventura, Calif., Thunderbird Corp. at Kyrene, Ariz. and Standard Oil of Ohio at Lima, Ohio—or in the financing stages also plan to use the newer processes.

Both Deere and Grace use France's Pechiney process.

• Pechiney Process

CO_2 and NH_3 react at 3,000 psi. and 360° F. in the presence of a circulating mineral oil. The ammonium carbamate formed in the reaction disperses in the oil, which also holds recycle ammonium carbamate formed by absorbing unconverted gases from the stripper. The carbamate-containing oil goes to the stripper where the carbamate decomposes to produce urea and water. Unconverted gases are stripped from this solution and taken off overhead. The urea solution passes to a separator to decant the mineral oil, which then absorbs unconverted gases. These condense in the oil as solid carbamate crystals and this slurry is recycled.

FEATURES—Mineral oil serves as heat transfer medium in the reactor and, by coating autoclave walls, cuts corrosion and extends equipment life.

• Inventa Process

Liquid NH_3 and CO_2 react at 3,000 psi. and 360 to 390° F. The ammonium carbonate formed decomposes to urea and water at 80 psi. in the stripper and unconverted NH_3 and CO_2 are removed from the urea solution. An aqueous urea nitrate solution selectively absorbs the ammonia, which is later removed, compressed and recycled. This gas separation step skirts the touchy problem of recompressing recycle carbamate—a troublesome step in other processes.

FEATURES—A special (and undisclosed) alloy lining is reported to solve corrosion problems and eliminate contamination with toxic metal salts. Heat given off at the autoclave goes to generate steam. The process claims low maintenance, high conversion per pass and relatively high product purity.

• Chemico Process

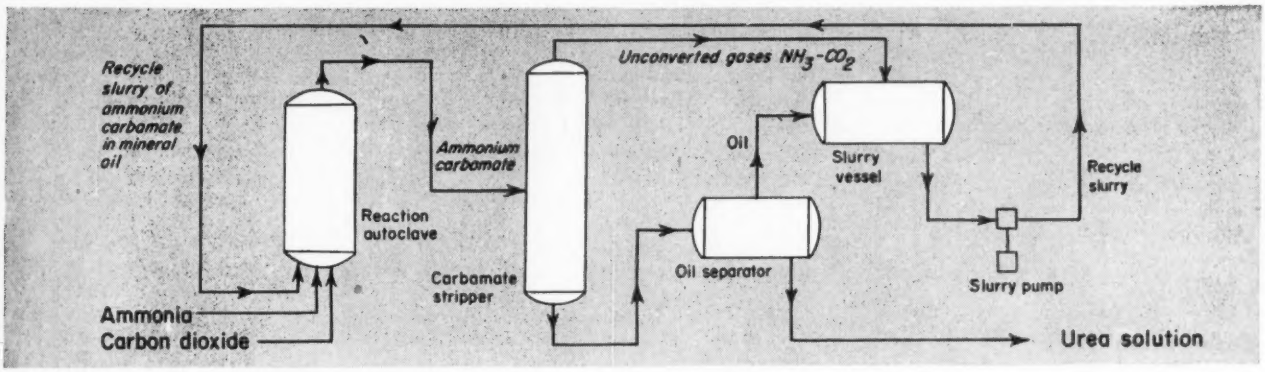
Liquid NH_3 and CO_2 react at 2,500 psi and 345 to 355° F. As much as 200% excess ammonia is used to boost conversion. Nearly all of this is stripped from the autoclave product, condensed and recycled with feed make-up. No gas compressor is needed. Unconverted NH_3 and CO_2 gases are separated by absorbing the CO_2 in a monoethanolamine solution. The NH_3 is liquified by condensation. Both are recycled to the autoclave and the monoethanolamine is regenerated and reused.

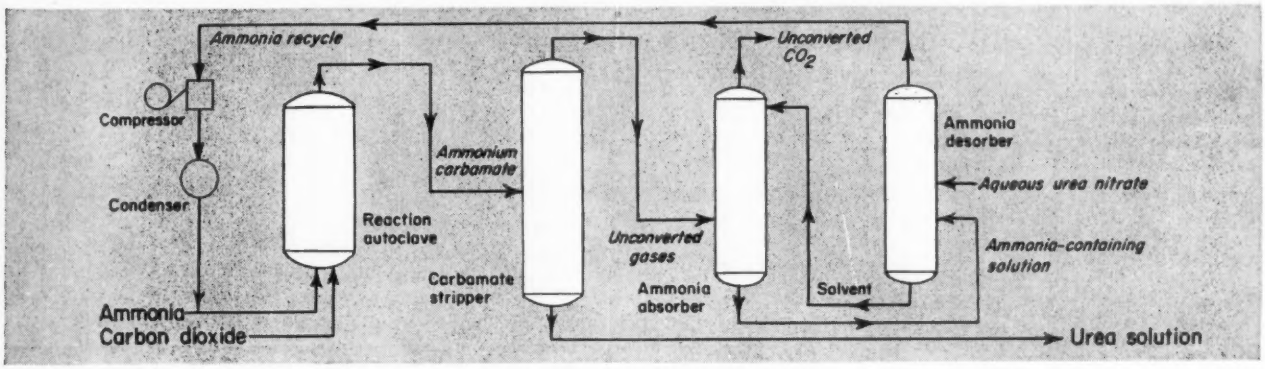
FEATURES—The excess NH_3 not only hikes yield but it also acts as a heat transfer medium. The process claims several economic advantages, i.e. little more than half as much CO_2 to compress, less than 20% as much NH_3 to compress in recycling, far less gas to handle in separation units.

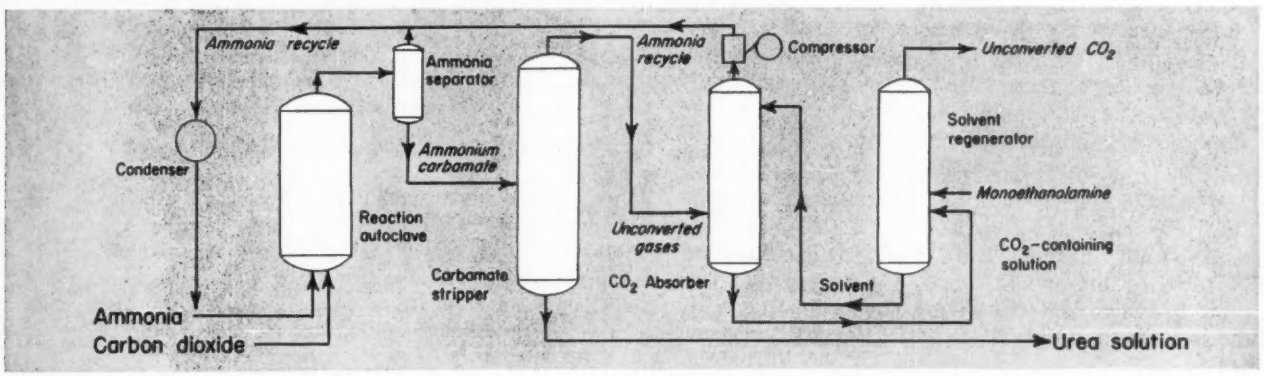
• Montecatini Process

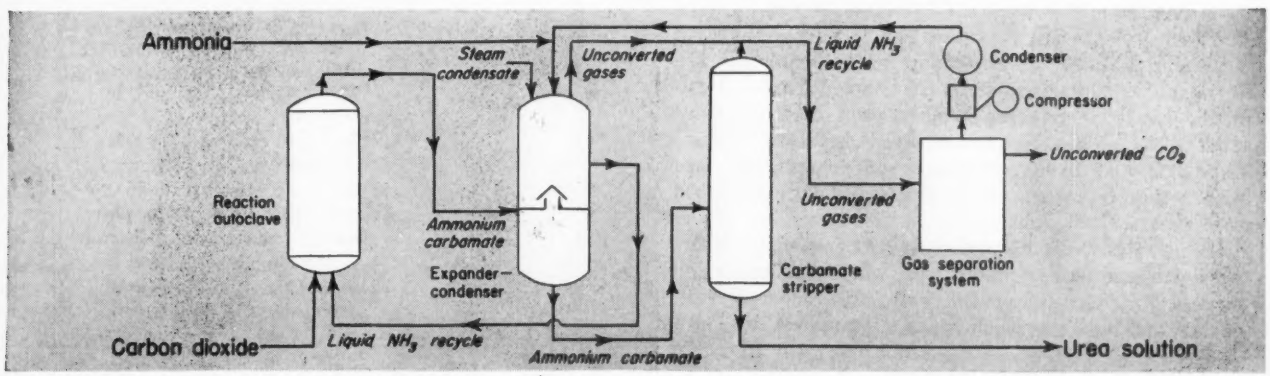
Compressed CO_2 reacts with recycle liquid NH_3 containing some ammonium carbamate and water at 2,275 to 2,560 psi. and 320 to 360° F. Carbamate formed in the reaction passes to the expander-condenser. Together with some unconverted CO_2, the NH_3 from the expander section mixes with steam condensate and make-up ammonia in the condenser section to form the recycle. Carbamate goes on to the stripper which removes unconverted gases. NH_3 is selectively absorbed in aqueous urea nitrate, desorbed and recycled. Unconverted CO_2 is vented to the atmosphere.

FEATURES—Partial liquid recycle (a total liquid recycle process is being developed) keeps plant investment relatively low and cuts corrosion, permitting stainless steel reactor construction.


Recycle slurry of ammonium carbamate in mineral oil
Unconverted gases NH_3-CO_2
Ammonium carbamate
Oil
Slurry vessel
Recycle slurry
Reaction autoclave
Carbamate stripper
Oil separator
Slurry pump
Ammonia
Carbon dioxide
Urea solution


Ammonia recycle
Unconverted CO_2
Compressor
Ammonium carbamate
Ammonia desorber
Aqueous urea nitrate
Condenser
Reaction autoclave
Unconverted gases
Ammonia-containing solution
Carbamate stripper
Ammonia absorber
Solvent
Ammonia
Carbon dioxide
Urea solution


Ammonia recycle
Ammonia separator
Ammonia recycle
Compressor
Unconverted CO_2
Condenser
Ammonium carbamate
Solvent regenerator
Monoethanolamine
Reaction autoclave
Unconverted gases
CO_2-containing solution
Carbamate stripper
CO_2 Absorber
Solvent
Ammonia
Carbon dioxide
Urea solution


Ammonia
Steam condensate
Unconverted gases
Liquid NH_3 recycle
Condenser
Compressor
Unconverted CO_2
Reaction autoclave
Ammonium carbamate
Unconverted gases
Expander-condenser
Carbamate stripper
Gas separation system
Carbon dioxide
Liquid NH_3 recycle
Ammonium carbamate
Urea solution

Here's How Today's Urea Processes Stack Up . . .

Technically . . .

	Once[1] Through	Hot Gas[2] Recycle	Solution Recycle	Pechiney	Inventa[3]	Chemico	Montecatini
Mol ratio in the reactor, CO_2–NH_3	1/2–3	1/2	1/5	1/2	1/2–3	1/6	1/3
Pressure, psi	1,750–3,000	1,750–1,900	6,000	3,000	3,000	2,500	2,275–2,560
Temperature, °F	320–390	320–340	390–410	360	360	345–355	320–360
Conversion of carbamate to urea %	30–60	40–45	70	50	50	76	68.5
Material requirements, T/T urea %							
Ammonia			0.58	0.58	0.58	0.58	0.83
Carbon dioxide			0.75	0.75	0.75	0.77	0.89

Economically . . .

Raw material costs, $/ton of urea	48.00	48.00	48.00	48.00	48.00
Utility Costs					
Power, $/T	2.80 *	1.30	3.64[4]	1.62	1.39
Water, $/T	0.50	0.75	0.73	0.33	0.20
Steam, $/T	2.50	2.00	2.16	1.80	1.20
Labor and supervision, $/T	3.40	4.64	4.13	3.60	5.86
Maintenance, $/T	6.06	2.00	3.81	4.00	2.41
Depreciation and taxes, $/T	16.00	13.00	10.90	9.20	7.34
Manufacturing costs, $/T	79.26	71.69	73.37	68.55	66.40[6]
Selling price, $/T	120.00[5]	120.00[5]	120.00[5]	120.00[5]	120.00[5]
Investment required, $1,000/ton/day	20–40	15–25	30–40	12–30	21
Economic plant size, Tons/day	100	100	100–150	150	50–100
Licensee	....	Foster-Wheeler Corp.	Vulcan Copper & Supply Co.	Chemical Construction Co.	.....
Size of plant on which costs are based, Tons/day	100	100	100	150	100

[1] Cost data not available. [2] Outdated process—not used in the United States. [3] Cost data represent earlier European plant experience, since improved by further research work. Current data are not available. [4] With gas engine drives for compressors, electrical energy requirements amount to $0.47 per ton of urea for power; $0.69 per ton of urea for fuel gas. [5] Prices for industrial crystal urea, as delivered, on August 1, 1955. [6] Cost figures based on process using partial liquid recycle, not on just-developed total liquid recycle process

Shell will employ Italy's Montecatini process in a 100-tons/day plant which it aims to put into operation by next September—in time for next year's fertilizer season. The Swiss Inventa process will get its first U. S. trial in the 120-ton/day plant which Standard Oil of Ohio has slated for completion at the end of this year. Chemico's process has yet to be employed in this country, although it is used by the Sumitomo Co. in a 120-tons/day plant at Niihama, Japan.

Where It Goes

Current producers are vying for a market estimated* to be about 330,000 tons for this year. Some market seers predict a 620,000-tons/yr. market within the next two years. And the President's Materials Policy Commission has determined that requirements of urea for use in plastics—now estimated at less than 60,000 tons would reach about 122,000 tons by 1975.

Though this is the top industrial outlet, it trails urea's two agricultural outlets—animal feed, where it is used as a source of protein and which now takes some 70,000 tons/yr., and fertilizer, which is urea's top market at a current 200,000 tons/yr., and which has plenty of room for growth.

Urea's ready solubility and its high percentage of available nitrogen (46.7%), coupled with its noncorrosive and nonexplosive nature also fits it for use in other products. It appears as a chemical intermediate; in adhesives; in finishes for leather, textiles and paper; and in herbicides and defoliants. It is sold either as crystals or as a prilled granulated product.

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* Chemical Week, July 23, 1955, p. 77.

DRYING

METHODS & EQUIPMENT

CHEMICAL ENGINEERING REPORT—OCTOBER 1955

By WALTER C. LAPPLE and WILLIAM E. CLARK, Midwest Research Institute

DRYING can be considered in the broad sense as removal of a liquid from a gas liquid or solid. Under this general definition of drying would be included a number of different chemical engineering techniques or unit operations such as vaporization, absorption, adsorption and mechanical separation.

Of these unit operations only vaporization embodies principles of heat transfer for moisture removal. Of course, evaporation also involves removal of moisture by vaporization. But the use of this term is usually restricted to an operation in which large quantities of water must be removed from solutions at their boiling points.

It has thus been common practice in chemical engineering to apply the term drying to thermal means of moisture removal—vaporization—from solids or nearly solid materials. With the exception of vacuum drying the majority of commercial dryers utilize circulating hot air or another gas as a carrying medium for the moisture which is vaporized. In general, the drying is accomplished at temperatures below the boiling point of the liquid.

The current report (in two parts) on drying is centered around those broad aspects of drying coherent with this latter definition of drying.

This first part of the report will present some of the theoretical aspects of drying and acquaint the reader with the types of dryers commercially available to the chemical industry. In the second part emphasis will be placed on the practical technique which may be used in applying theory or other past knowledge to preselect and size drying equipment suitable for a given service from the standpoint of technical and economical feasibility.

Nearly every solids process needs drying, but the dryer user must be able to answer many complex questions before he can make a technically and economically correct choice.

Providing the bases for such choices was the reason behind our authors' preparation of this and a subsequent report.

Basic theory, types principles and comparative advantages of dryers are all included, along with methods for dryer sizing and cost estimating.

The purpose of both parts is to make a preliminary selection of a dryer as simple and accurate as possible with the data available at present. A further hope: that much of the discussion will be applicable to the final selection as well.

Basically, a drying operation involves the two mechanisms of heat transfer and mass transfer. Heat must be supplied to the material in order to vaporize the liquid to be removed and then the vapor and/or liquid must be transferred from the solid into the carrier gas stream. In general, the rate of which moisture can be vaporized from the surface is then governed by two rates. The first: the rate at which heat is applied to the surface. The second: the rate at which moisture can diffuse from inside the material being dried, provided that the drying medium is unsaturated at operating temperature.

A proper understanding of a particular drying problem requires, first of all, knowledge of the manner in which the moisture is associated with the material to be dried.

Surface moisture occurs at the external boundaries of a material and completely wets the top surfaces. The rate of vaporization of this type of moisture from a surface is predictable and easily controllable.

Internal moisture is contained in the interstices of the material and moves to the surface by diffusion, capillary action, pressure gradients due to shrinkage, etc. Migration of moisture from the interior of the material

may be inherently very slow. Surface checking, cracking and glazing may occur. Considerable care must often be exercised to prevent this, for checking and cracking may be harmful for the intended subsequent usage of the product and glazing may greatly reduce the rate of drying. Control of temperature and ambient humidity is essential in such cases.

The third form of moisture, combined moisture or water of crystallization, is chemically bound moisture. Removal of this form of moisture must be accomplished at temperatures above the decomposition level. Close regulation of temperature as well as retention time may be necessary, particularly if only partial removal of the water of crystallization is desired.

Application of Heat

The transformation of a liquid to a vapor state is accompanied by the absorption of heat. Vaporization of water requires approximately 1,000 Btu. per pound of water evaporated. It requires relatively little heat to raise the temperature of material to a point where it will vaporize rapidly. Thus, in general, the greatest proportion of the total heat load is the heat for vaporization. Most industrial drying applications involve vaporization of water at rates from several hundred to several thousand pounds per hour.

There are three ways in which heat for vaporization may be transferred:

Radiation, such as the way in which heat passes from the sun to earth. Similarly, in the case of radiant heating for drying, the waves of heat emitted from a heater pass to the surface to be heated or dried but do not heat the air in the intervening space to any great extent. Radiated heat penetrates only the top surfaces. Further heating of the inside of the material occurs only by conduction. Heat transfer into the interior, however, is governed by the surface temperature and does not take place at any faster rate than could be achieved if the same surface temperature were maintained by other methods.

Conduction, such as the way in which heat travels through a rod when one end is heated.

Convection, such as the way in which a house is heated by hot air.

Electronic, or dielectric, heating, a special class in itself, is the only means for developing heat which evenly distributes heat throughout the material without the aid of conduction. This is accomplished by the use of ultra-high frequency current produced in the medium between two electrodes.

Frequently all three forms of heat transmission may be utilized to some extent in commercial drying operations. In general, however, if the material can be subjected to air currents as a means of conveying heat, then convection drying is the most economical and controllable. In fact, it is probable that convected heat is used in 90% of all the commercial drying applications. Discussion in the equipment section will indicate why this is so.

Because of the prime importance of drying by convected heat in the chemical and allied industries, further discussion of some of the basic aspects of drying will be mainly concerned with the principles of drying by air.

Air as a Drying Agent

Air flowing over a material being dried has a definite carrying capacity for water vapor depending on the temperature. Its capacity to hold moisture increases with temperature. If the temperature is reduced, a point is reached at which condensation occurs. This temperature is known as the saturation point or dew point and corresponds to a definite amount of water vapor per unit weight of air. For every temperature there is such a limit.

From the standpoint of heat economy it would be desirable to discharge the moisture-laden air from the dryer at its saturation point. To avoid condensation difficulties, though, a dryer is usually operated so that a relative humidity of 50 to 80% in the waste stack gases is not exceeded. However, when heat for drying is applied by conduction or radiation, use of a minimum quantity of air to remove water vapor is usually of greatest significance since air in excess may impose a substantial added heating load.

Constant Rate Drying

All liquids exert a definite vapor pressure at a given temperature. The vapor pressure of surface moisture on a solid is very close to that of a pure liquid at the same temperature. If

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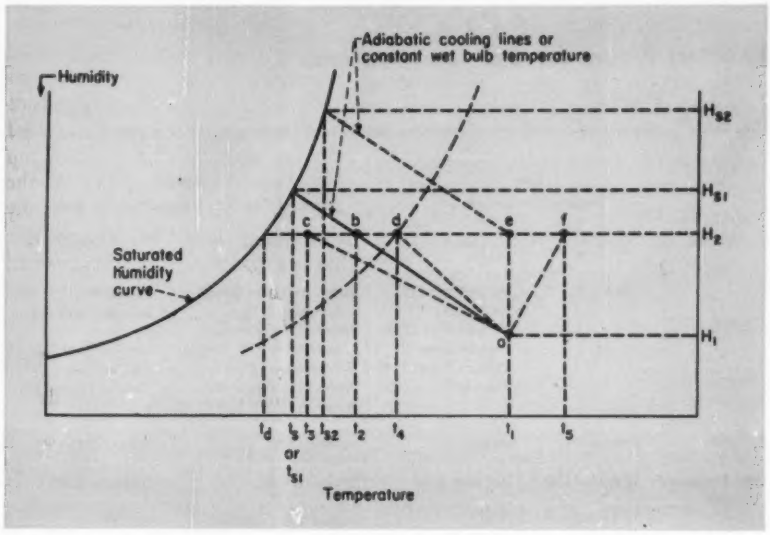
WILLIAM E. CLARK

the partial pressure of the vapor in the surrounding air is less than the vapor pressure of the liquid, vaporization will occur. This difference in the water vapor pressures provides the driving force for removal of water from the surface of a material. So long as the surface of the material is entirely wet the drying rate is proportional to the difference in the vapor pressures.

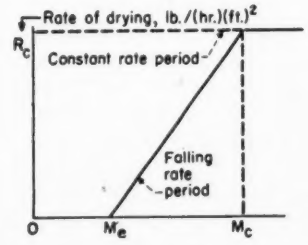
This mechanism of drying occurs as long as the flow of water by diffusion or otherwise from the interior of the material is adequate to keep the surface of the material completely wetted (even though the average moisture content of the material is being steadily reduced by evaporation from the surface). If the temperature, humidity and velocity of a current of warm air passing over a wetted surface are maintained essentially constant the material attains a constant equilibrium temperature. At this temperature the sensible heat transferred from the air into the material is exactly equal to the heat rendered latent by evaporation of the water. The rate of evaporation thus remains constant since all of the drying conditions are constant.

These conditions characterize the so-called constant rate period of drying.

In the prediction of drying rates it is important to be able to estimate the temperature of the drying surface. In the constant rate period of drying the higher the temperature of the material surface the greater is the water vapor pressure at the surface and the greater is the rate of drying. All of the heat received at the surface of the material may be transferred by convection from the air only. If so, the temperature of the surface will closely approach the wet-bulb temperature of the drying air. If additional heat is received by radiation or conduction the temperature reached by the surface in normal dryer operation is greater than the wet-bulb temperature but less than the dry-bulb temperature of the air.



HUMIDITY CHART for air-water vapor mixtures—Fig. 2.



Average water content of stock, % by weight on a dry basis—Fig. 1.

R_c—Rate of drying in constant rate period
M_c—Total moisture content at critical point
M_e—Equilibrium moisture content

Falling-Rate Drying

During the course of any drying cycle a point will be reached when the drying surface is no longer completely wetted with liquid, i.e., the effective evaporating surface begins to decrease. Then the rate of moisture movement by diffusion in the solids—instead of difference in vapor pressures—becomes the controlling factor in determining the rate at which moisture can potentially be vaporized into the air stream. The average percentage of moisture in material at this point of the drying cycle is called the critical moisture content.

Drying then proceeds at a continually decreasing rate. During this stage of drying, called the falling rate period, the air film accounts for only a small part of the resistance to heat and mass transfer. The velocity and humidity of the drying air no longer exert much effect on the drying rate. Other factors, such as temperature and moisture gradients in the material, assume a role of greater relative importance.

As the moisture content of the material diminishes during this period of drying, its temperature increases and finally approaches the temperature of the drying air. On the other hand, the lowest moisture content to which a solid can be dried with air at a given temperature, humidity and pressure is designated as the equilibrium moisture content.

In summary, under constant drying conditions a drying operation consists of two stages, a constant rate and a falling rate period, which can be expressed graphically as shown in Fig. 1.

Variable Drying Conditions

The discussion above is restricted to practices carried out under constant drying conditions: stock temperature, air temperature, humidity, air velocity and direction are unchanged. In actual dryer operations material is dried by air of constantly varying temperature and humidity. Stock temperature may change too. Conditions remain constant at any particular point but may vary from point to point in the dryer. In the case of intermittent or batch dryers the drying rate varies both with time and position of the material in the dryer. The latter type of drying equipment is generally to be avoided because of its low drying efficiency and

To Select Proper Dryer for Your Material

This table (I) gives code numbers of possible equipment for your class of material; use Table II to locate details

Application of Heat	Class I Material Can Be Pumped		Class II Material Cannot Be Pumped But Can Be Stirred		Class III Material Can Be Neither Pumped nor Stirred	
	Continuous	Batch	Continuous	Batch	Continuous	Batch
Conduction	Drum (10, 11)	Jacketed Shelf (8) Pan, Kettle (9) Vacuum Shelf (25) Vacuum Drum (26) Vacuum Rotary (27) Vacuum Freeze (29)	Screw, Paddle or Trough Conveyor (17) Jacketed Vibrating Conveyor (19) Indirect Rotary (21) Steam Tube Rotary (22) Rotary Jacketed Shell (14)	Cone (28) Jacketed Shelf (8) Pan, Kettle (9) Vacuum Shelf (25) Vacuum Rotary (27) Vacuum Freeze (29)	Cylinder (32) Platen (34)	Platen (34) Jacketed Shelf (8) Vacuum Shelf (25) Vacuum Freeze (29)
Radiation	Infrared (39)	Infrared (39)	Infrared (39)	Infrared (39)	Infrared (39)	Infrared (39)
High Frequency Current	Dielectric (38)	Dielectric (38)	Dielectric (38)	Dielectric (38)	Dielectric (38)	Dielectric (38)
Convection	Spray (35)		Tunnel: truck belt and screen (12) Turbo (13) Moving Bed (15) Tower (16) Vibrating Conveyor (18) Direct Rotary (20) Louver (24) Filter (30) Centrifugal (31) Flash (36) Fluid Bed (37)	Air (1) Room, Loft, Kiln (2) Shelf, Tray (3) Cabinet, Compartment (4) Truck (5) Fixed Bed (6) Vapor (7)	Tunnel: Truck, belt and screen (12) Filter (30) Sheeting (33)	Air (1) Room, Loft, Kiln (2) Shelf, Tray (3) Cabinet, Compartment (4) Truck (5) Fixed Bed (6) Vapor (7)
Combination of Above			Direct-Indirect Rotary (23)			

the non-uniformity of temperature to which the material being dried is subjected. The performance of this type of dryer is also difficult to treat mathematically, since the solution requires the use of partial differential equations.

The performance of different types of dryers can best be described by reference to the air water vapor humidity chart shown in diagrammatic form in Fig. 2. Point *a* represents the hot air condition at the inlet to the dryer and corresponds to a temperature of t_1 and humidity of H_1. If the dryer is operated adiabatically, the operating line coincides with line *ab*. The air discharged at *b* has a humidity of H_2. At this point the dry bulb temperature, the dew point and the wet bulb or adiabatic saturation temperature of the air are t_2, t_d and t, respectively. If heat is lost to the surroundings the slope of the operating line ac is less than that of the adiabatic cooling line. If additional heat is added throughout the dryer to maintain constant temperature the operating line *ae* is vertical. If less than this amount of heat is supplied the resulting operating line is some such line as *ad*. If more is supplied the operating line slopes upward and to the right as indicated by line *af*. Among other considerations in practice, the operating line may be established so that some given relative humidity, of say 50%, is not exceeded in the exit stack gases, as demonstrated by line *ad* drawn on the humidity chart.

Indirect Drying

Indirect drying (radiation and conduction) is a subject which is in need of further theoretical and experimental investigation. In indirect drying the heat required for vaporization is transferred by radiation or conduction through a complex series of resistances generally encountered between the heating medium and the material being dried. Since the removal of moisture from the drying equipment is not accomplished by means of a carrier gas, the stock will assume a temperature at which the vapor pressure exceeds the surrounding total pressure. As long as the drying surface is completely wetted this temperature is approximately the same as the boiling point of the pure liquid at the pressure or vacuum within the dryer.

In indirect dryers constant and falling rate periods of drying are also experienced. During the period of constant temperature the thermal resistance of the stock is usually small in comparison with the total resistance. But during the falling rate period of drying thermal resistance may become progressively and substantially greater with corresponding decreasing values in the drying rate.

The drying rate may also depend largely on the degree of solids mixing peculiar to the design of the dryer under consideration. Due to the com-

Drying Equipment—Table II

These dryers. . . . on these pages

Stationary

1. air or solar 197
2. room, loft, kiln 197
3. shelf, tray 197
4. cabinet, compartment 197
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7. vapor 198
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13. turbo 201
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Vacuum

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28. cone 207
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Combination

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Web

32. cylinder 207
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34. platen 207

Suspended Particle

35. spray 208
36. flash 209
37. fluid bed 209

Special

38. dielectric 210
39. infrared 210

plexity of the situation the performance of an indirect dryer is frequently defined by some form of the general heat transfer equation:

$$q = UA\Delta t$$

where U is an average overall heat transfer coefficient and Δt an average temperature difference over a portion of the drying period or over the entire cycle.

How to Pick a Dryer

Preliminary selection of a dryer usually requires two steps:

- List the dryers which can handle the material to be dried and which will discharge a product suitable for subsequent operations in the process as a whole.
- Estimate the total cost (fixed cost plus operating cost) for each of the dryers in the list. Then eliminate those dryers with high total costs (say 2½ times the lowest).

Final selection of a dryer from this preliminary list will proceed as follows:

- Conduct pilot plant tests to check the ability of the dryers to handle the material, to size the dryers, to determine the dryer operating conditions.
- Make the final selection of the dryer on the basis of the operating data provided by the pilot plant tests and firm quotations from the manufacturers.

It is desirable to eliminate as many dryers as possible in the preliminary selection. Otherwise considerable time and expense will be involved in obtaining specific operating data, required for final selection, in the pilot plant facilities maintained by dryer manufacturers.

Classification of drying equipment according to the principal method used in transferring heat to the liquid being vaporized is convenient for selection of the correct theory to be applied in analyzing the operation of the dryer. But the engineer faced with the task of choosing a dryer for a particular process will find another system of classification more convenient. This system lists the dryers according to the type of material usually handled by the dryer.

Since each method of classification has its advantages they have been combined in Table I as an aid to the engineer in the preliminary selection of a dryer for industrial applications. In addition, the dryers have been subclassified as batch or continuous.

In general all materials to be dried will fall into three classes. These are: (1) Substances which can be pumped; (2) those which cannot be pumped but can be stirred; and (3) those which can be neither pumped nor stirred. Each classification has been used in Table I.

True solutions, collodial suspensions and some heavier suspensions fall into Class I. Solids from a fraction of an inch to several inches in size which are able to withstand some mechanical action fall into Class II. Solids which cannot be stirred because of their size, shape or fragility fall, in turn, into Class III.

In some cases the material to be dried may lie on the borderline between two classes. In such borderline cases the use of a dryer which can handle both classes may be the best practice—for example, the vacuum rotary for Class I and Class II batch operations.

Sometimes additions can be made to a material to remove it from the borderline. For example, liquid may be added to a feed on the line between Classes I and II to produce a material more easily handled by a Class I dryer. Or a portion of the dried product may be recirculated with the feed to make the material more easily handled by a Class II dryer. However, such treatments are usually undesirable because the volume of material passing through the dryer is increased.

More detailed attention will be given to the type of material handled by each dryer in a later discussion of the individual dryers. Meanwhile the factors involved in the choice of a continuous or batch dryer will be considered.

Batch or Continuous?

In general a continuous rather than a batch dryer should be selected. A continuous dryer of given type and capacity will require less labor, fuel, floor space and will discharge a more uniform product than the corresponding batch dryer. In addition, most chemical manufacturing processes are

continuous or will be made continuous in the future. So in most cases a continuous dryer will fit into the overall process better than a batch dryer.

However, the batch dryer is low in first cost, inexpensive to maintain, easy to operate and extremely versatile in its possible applications. Therefore, it should be chosen in certain cases. For example, because the batch dryer is inexpensive to build and maintain it should be selected when the dryer will be idle for any appreciable length of time. Because it is flexible and easy to operate it should be selected when it will be used to dry several different materials or when it will be used for laboratory work or when it will be used on material requiring close control during the drying cycle.

From the considerations above, the column, or possibly columns, of dryers in Table I applicable to any particular material (Class I, II or III) and manufacturing process (batch or continuous) can be determined.

This list of potential dryers can be reduced still further by taking into account the advantages and disadvantages of the various methods of transferring heat to the material being dried (convection, conduction, radiation, etc.)

Convection Dryers

In the case of heat transfer by convection, temperature control is easily accomplished by measuring and controlling the temperature of the heated air. The temperature of the material being dried cannot exceed at any time the temperature of the surrounding air. Close regulation of the air temperature will thus assure that the material is not subjected to temperatures above a specified maximum.

In general, the convection dryer should be considered first because the initial cost for a given capacity is less than most other types. Furthermore, if corrosion is a problem a convection dryer can be protected rather easily. If a low drying temperature is desired a convection dryer can be operated so that the temperature of the material being dried does not rise far above the wet-bulb temperature of the heating medium. This temperature usually is less than 160° F. and can be held even lower.

However, the convection dryers have several disadvantages. For example, they tend to be thermally inefficient in many cases due to the high sensible heat loss in the stack gases. Solvents are difficult to recover. Dusting and the resulting loss of products can be a serious problem with fine materials. The product may be contaminated by substances in the drying medium. Oxygen or other gases in the drying atmosphere may react with the material being dried or with the solvent being evaporated.

These disadvantages can be eliminated in large part through the use of special auxiliaries and operating techniques. The thermal efficiency of a convection dryer can be improved by recirculating a portion of the exhaust air. (Actually, thermal efficiency is of little importance when a waste heat source such as a flue gas stream is available.)

Solvents can be removed from the exit air stream by means of a chemical reaction, absorption or adsorption, or by cooling the air below the dew point.

Dusting can be reduced by using lower air velocity or by predrying or preforming the charge into sticks which will be relatively free of dust. Dust which carries into the exhaust air ordinarily can be recovered in wet scrubbers, cyclones or a baghouse.

Contamination may be avoided by filtering, washing or otherwise pretreating the drying medium to remove the undesirable components. Oxygen or other reactive gases may be excluded by use of a suitable inert gas or superheated vapor as the drying medium.

It should be noted, however, that the expenses involved in the auxiliary operations enumerated above may raise the cost of a convection dryer to the point where other types of dryers become competitive or in some cases more economical.

Conduction Dryers

Because of temperature extremes which may be involved when heat transfer is accomplished solely by conduction, this method of applying heat for drying has its drawbacks if proper precautions or controls are not exercised. Nevertheless, if a drying temperature equal to the boiling point of the liquid being evaporated can be tolerated a conduction dryer should be considered when thermal efficiency, solvent recovery, minimum dusting, minimum contamination, or exclusion of undesired gases is of importance. However, the first cost of a conduction dryer is higher than that of the corresponding convection dryer because a jacket or double shell must be provided to contain the heating medium.

Radiation Dryers

Radiated heat by itself for use in drying is somewhat limited because of its inability to penetrate into solid material, because of the relative high cost of employing it, and because of some difficult problems encountered with temperature control to insure even heat distribution and uniform product quality.

But radiant heat can be used to advantage, particularly in the case of materials which are in the form of thin sheets such as textile fabrics, paint films, etc., and which contain only small quantities of liquid to be evaporated. With reference to the drying of paint films, it is desirable to avoid currents of air which may convey dust particles to the tacky surface.

In the case of radiated heat—unlike that of convected heat—air temperature cannot serve as a basis of temperature control since the space between the radiating surface and the material being heated is not directly influenced.

Thus, for any given drying application of infrared rays it is necessary to determine experimentally the conditions governing the temperature of the product in order to establish the proper procedure for achieving the desired results. The essential independent variables affecting heat transfer by radiation are: (1) The temperature of the radiating source, (2) the distance between the radiating source and the material to be dried, and (3) the time during which the material is subjected to radiated energy or the speed at which the material passes through the drying zone.

Infrared (radiation) dryers—and dielectric dryers—ordinarily have high heat generation costs. They are used mostly for Class III materials when

these heat costs are not so important and when advantage can be taken of their particular operating characteristics.

Stationary Dryers

Air Dryer

Air or solar drying is the oldest and probably the most widely practiced of all drying methods because it requires no expense for fuel and very little or none for equipment. It is commonly used for the drying of farm and food products.

The method of exposing the material to drying conditions differs with custom and with the product. Most commonly the material to be dried is spread on trays which are placed in the open. The trays may be carried by hand or they may be placed on trucks and wheeled over tracks. In any case considerable labor is required to handle large volumes, and mechanical dryers have been increasingly used although the capital cost is higher.

Some of the other factors which have precluded more extensive use of air drying: a large area is required, the rate of drying is slow and weather dependent and the final product is non-uniform and non-hygienic.

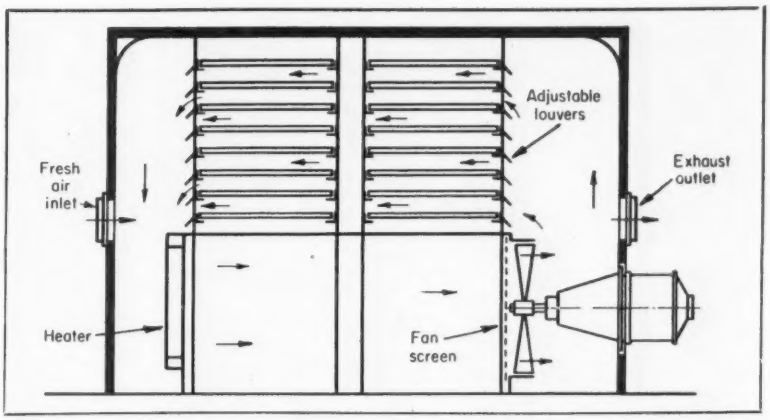
Room, Loft and Kiln Dryers

Room, loft and kiln dryers are similar and the names often are used interchangeably. Usually a room dryer is just that: a room with a heater and shelves, hooks or other holders for the material being dried. A loft dryer has an upper level which contains the drying load. This level may be unheated like a hayloft or heated internally like a room dryer, or heated from below by warm air passing through openings in the floor. The charge can be placed on the floor and raked intermittently to speed the drying process and to produce a more uniform product. This type of dryer also is referred to as an evaporator or as a kiln.

A rotary dryer infrequently is called a kiln dryer, but the latter term most commonly is applied to a type of lumber dryer. The lumber kiln usually is a one-story structure in which the boards are stacked for drying. The lumber can be placed on trucks which are pushed into the kiln or it may be stacked directly on the floor of the kiln. When trucks are used the kiln may be operated on a semi-continuous basis as a tunnel dryer by withdrawing a truck at one end as green lumber is charged at the other.

Usually finned steam tubes at the top, or sometimes at the bottom beneath the load, are used to heat the air. Hot air ducts can be used. Natural convection can be utilized to provide circulation but fans are commonly installed in modern kilns. Since controlled humidity is an important factor in the drying of lumber, steam or water sprays are installed to add moisture to the circulating air.

Although room, loft and kiln dryers represent an advance over solar or air drying in that they are more nearly independent of weather, they are not widely used except for the drying of forest and farm products.



TRAY dryer uses partial recycle and reheating of air (Proctor & Schwartz)—Fig. 3.

Shelf, Tray, Cabinet and Compartment Dryers

Shelf, tray, cabinet and compartment are general descriptive terms applied to dryers. They are not exclusive terms; for example, the tray dryer may also be a cabinet dryer. All are stationary, heated enclosures and most use fans to circulate the drying air over or through the material being dried (Fig. 3). A dryer with a single drying chamber usually is called a cabinet dryer while one with two or more chambers often is known as a compartment dryer. If the charge is held on shelves the dryer is a shelf dryer and if it is placed in trays it is a tray dryer.

These dryers can handle almost any feed material, and are the most commonly used batch dryers for experimental and small-scale work. For example, such diverse dryers as the laboratory oven and the home clothes dryer can be classified as cabinet dryers. They have the usual inefficiencies discussed earlier of batch and convection dryers, but these can be overlooked in certain applications because of the convenience provided by simple operation.

Truck Dryer

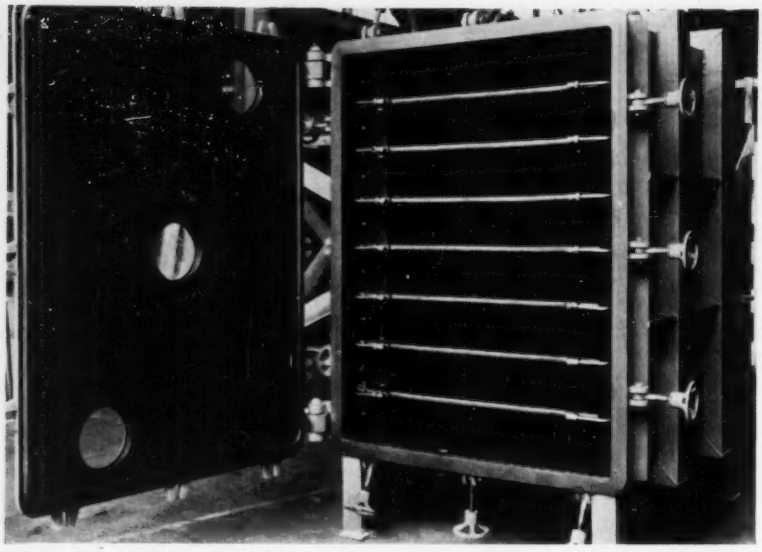
The truck dryer is a variation of the cabinet dryer developed to reduce operating costs. The load is placed in trays in the truck which is rolled into the drying cabinet. When the cabinet is elongated so that it can hold several trucks in series the truck dryer becomes a tunnel dryer.

Fixed-Bed Dryer

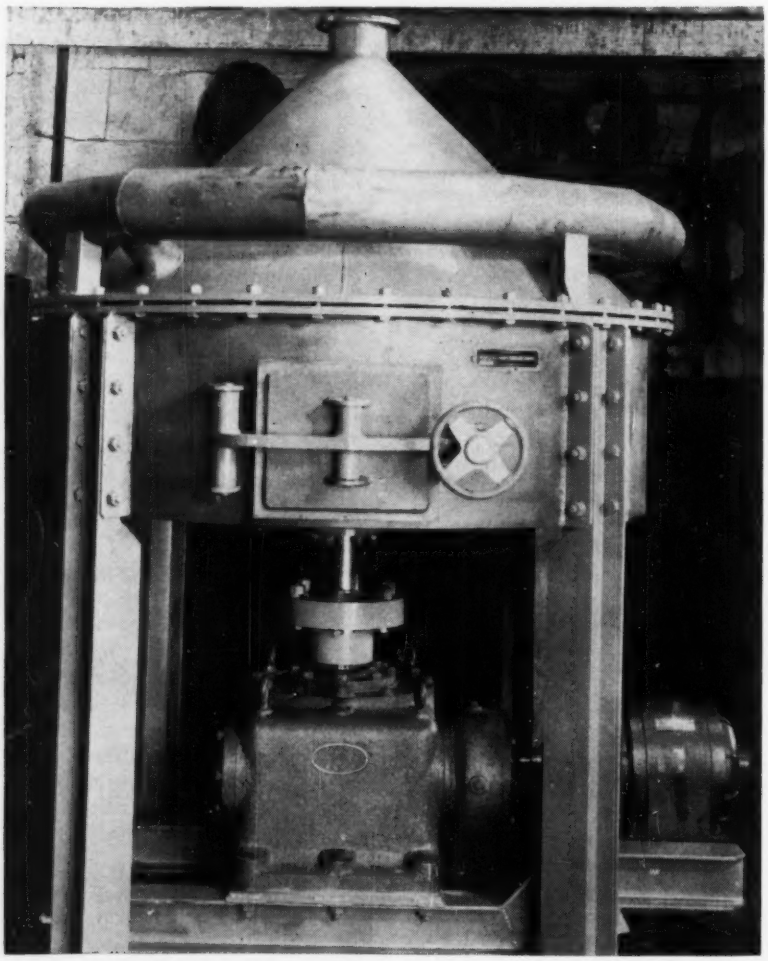
The fixed-bed dryer accomplishes, essentially, the drying of materials stored in a bin or otherwise held in a semi-permanent bed.

Usually, warm air is blown through the bed from bottom to top but several theoretical considerations indicate that better results could be obtained by drawing the air through the bed from top to bottom. These are: (1) none of the warm air is lost by leakage; (2) drying occurs under a slight vacuum; (3) if moisture in the air is recondensed as the air cools, it can pass to the bottom of the bed and eliminated without being re-evaporated.

Usually drying is slow because low



JACKETED SHELF dryer designed for vacuum operation (F. J. Stokes)—Fig. 4.



PAN dryer equipped for solvent recovery (Bethlehem Foundry & Machine)—Fig. 5.

air velocity must be maintained to avoid an excessive pressure drop through the bed. And the bed always is dried non-uniformly because that portion near the warm air inlet is necessarily dried more completely than that at the outlet. Nevertheless, the fixed bed dryer finds use because it is inexpensive and convenient in certain cases.

Vapor Dryer

The vapor dryer has come into commercial use within the last 10 years. At present this use is limited to the drying of wood products such as railroad ties, prior to preservative treatment, but other applications may be developed.

The body of the dryer is a long horizontal cylinder. The charge is placed on trucks and rolled into the cylinder on tracks. Then the cylinder is closed and the drying agent is pumped into the bottom until its level has reached the tracks. Submerged steam coils vaporize the drying agent and the rising vapors heat the charge. Water is vaporized and passes out of the cylinder with the drying agent vapors to a surface condenser.

The condensed drying agent and water are separated by gravity. The water is metered as it flows to waste while the drying agent is returned to the cylinder. After the desired amount of water has been removed, the drying agent is pumped back to storage and a vacuum is applied to the cylinder to remove the drying agent absorbed by the charge.

The drying agent and the pressure can be changed to vary the drying conditions, and an alternating cycle of heat and vacuum can be used to minimize absorption of the drying agent by the charge. If the material to be removed is a liquid insoluble in water, superheated steam can be used as a drying agent.

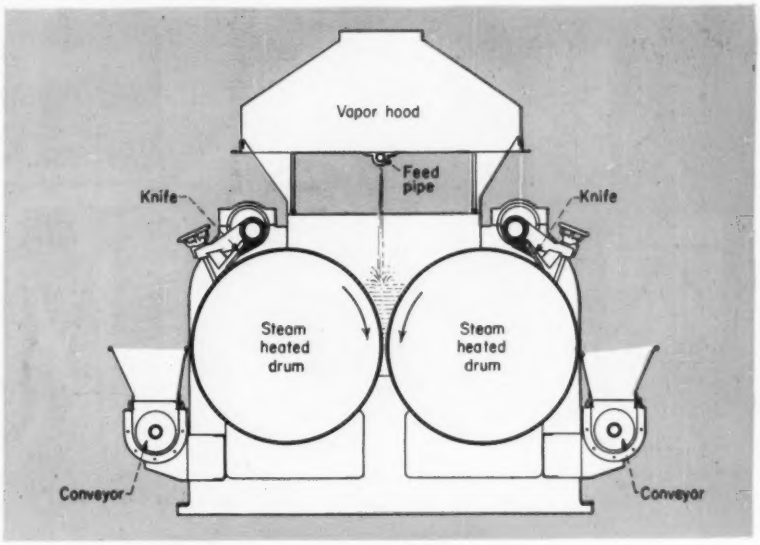
The vapor drying process is expensive, but unusually rapid drying and a product relatively free of checks and splits often can be obtained.

Jacketed Shelf Dryer

A jacketed shelf dryer consists of a chamber with horizontal jacketed shelves built into it one above another (Fig. 4). The material to be dried can be placed directly on the

shelves or it can be held in trays or other containers which are placed on the shelves. Heat is transferred by conduction from the shelf below and by radiation from the shelf above. Steam usually is the source of this heat, but Dowtherm, hot oil, or hot water can be used. Since the charge is not stirred the drying rate is low.

The jacketed shelf dryer has the usual disadvantages of a batch dryer. Add to these the high labor cost for charging and discharging materials being dried. However, it is flexible enough to be used to dry almost any material at practically any temperature and has gained wide use both as a vacuum and a vacuum freeze dryer for low volume, high value products such as pharmaceuticals and biologicals.



DOUBLE DRUM dryer with top feed for thin solutions (Buflovak)—Fig. 6.

Pan and Kettle Dryers

Pan and kettle dryers are similar. A pan dryer is a shallow circular jacketed vessel constructed especially for drying (Fig. 5). It has a discharge door on the side or bottom and a slow-moving stirrer. A kettle dryer can be any jacketed kettle which has been adapted for drying. For example, the Dopp kettle frequently is used for drying material which becomes pasty or viscous during the drying cycle.

Pan and kettle dryers are relatively inexpensive and can be converted easily to vacuum drying. They are versatile and can be used to dry almost any material in Classes I and II. However, they have the usual disadvantages of the batch and conduction dryers and are used primarily for low volume, infrequent operation.

Drum Dryers

Drum dryers, sometimes called film dryers, consist essentially of one or more horizontal rotating drums. The material to be dried is deposited in a thin layer on the outside of the drum and is scraped off with an adjustable blade after less than one complete revolution. The heating medium, usually steam, is contained within the drum and heat is transferred through the drum wall.

Drum dryers can be commonly purchased as single drums, double drum or twin drum units. The primary difference between the twin drum and the double drum is the direction of rotation of the drum. The tops of the drums rotate toward each other in the double drum dryer and away from each other in the twin drum dryer (Fig. 6). The double drum dryer can be fed conveniently by depositing material to be dried in the trough between the tops of the drums. The film thickness can be controlled by regulating the space between the drums.

This method of heating has a disadvantage if large solid lumps are present, since the lumps are forced between the drums and damage to the dryer may result. Therefore, the twin drum dryer was developed so that lumps would not be forced between the drums.

Drum dryers are also commonly fed by splashing material onto the drum or by dipping the drum into the feed. The advantages and disadvantages of the various feed methods can be found in the references[1-4] at the end of this article.

Drum dryers have the general characteristics discussed previously for continuous conduction dryers. They are particularly suited for materials on the borderline between Class I and Class II, materials too thick or lumpy for a spray dryer and too thin for a rotary dryer.

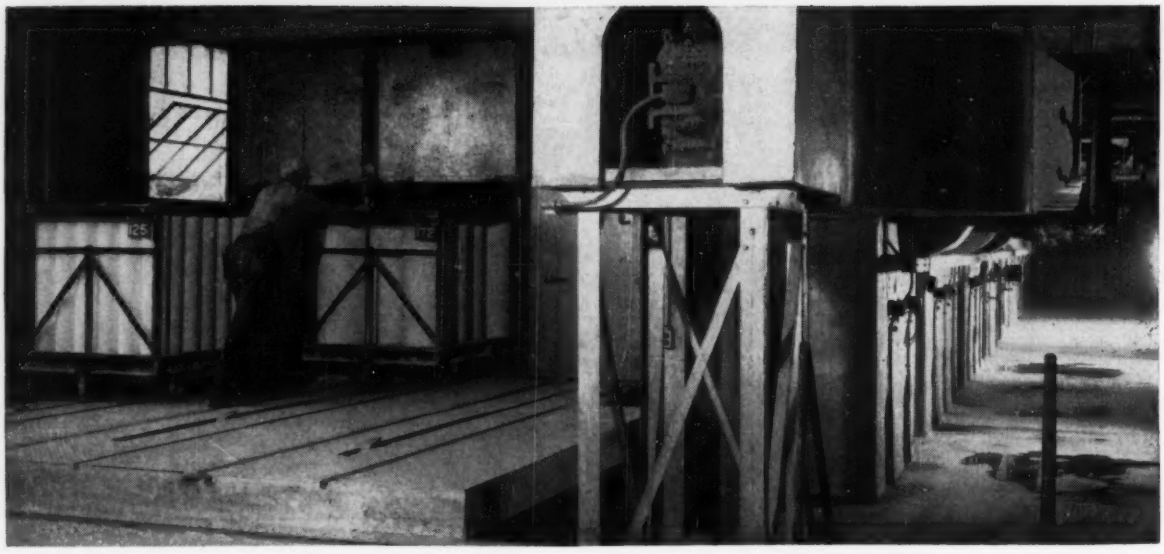
A feed suitable for a drum dryer may have a critical moisture content so high an extremely large drum would be required. Or the temperature sensitivity may be such that the material can be on the drum for only a short time. If so, the drum dryer can be used as a predryer and another dryer can be used to finish the drying operation. For example, a drum with parallel fins around its circumference can be used to predry and preform some materials which can be dried further in a conveyor dryer with little dusting.[9]

Conveyor Dryers

Tunnel Dryers

A tunnel dryer consists of a long enclosure through which trucks or other carriers pass as their charges are dried (Fig. 7). The heat of vaporization can be produced by radiation but usually it is carried by heated air blown over the material to be dried. The air flow may be along the tunnel or across it. When air is blown along the tunnel it may be forced from the truck inlet to the outlet so that flow is concurrent, or from the outlet to the inlet so that flow is countercurrent, or it may be exhausted somewhere in the middle of the tunnel so that flow is concurrent at the truck entrance and countercurrent at the exit.

In concurrent flow high temperature air can be used because it contacts wet feed, but low moisture contents



TUNNEL dryer being loaded via trucks. Fans and heat exchangers on side provide cross-flow heating—Fig. 7.

cannot be attained. In countercurrent flow low moisture content can be attained without case hardening, but often high temperature air cannot be used because of heat sensitivity of the dried product.

Since each flow has advantages a center-exhaust tunnel was developed. This tunnel can be considered as two dryers in one enclosure. High temperature air is used with concurrent flow at the truck inlet and low moisture content is obtained with countercurrent flow at the truck outlet.

The cross flow tunnel has fans and heat exchangers at the side of the tunnel. The temperature and humidity of the drying air can be controlled at any point along the tunnel and, because the air is recirculated, heat efficiency is good.

The concurrent tunnel usually is followed by another dryer which is used to reduce the moisture content to the desired level. The countercurrent tunnel often is preceded by a concurrent tunnel or other dryer which uses high temperature air for efficient removal of moisture during a constant rate period. The center-exhaust and cross-flow tunnels are used alone but they are more expensive to build and require more careful control.

Among the continuous dryers the tunnel dryer is relatively inexpensive in initial cost. Therefore it has been widely used in seasonal work such as the dehydrating of fruits and vegetables, even though the labor costs for unloading and loading trucks are high.

Since there is no agitation or stirring, tunnel dryers often are used for Class III as well as Class II materials.

The belt dryer is a form of tunnel dryer in which a moving belt is used to carry the charge. One of its advantages is that many materials can be continuously and automatically loaded and unloaded and labor costs thereby can be reduced. It is also useful for handling bulky objects that cannot be loaded conveniently in trays on trucks.

The screen conveyor is another type of tunnel dryer in which hot air (or some other gas) is forced up or down through the conveying screen and the material being dried. The drying rate is high because the area exposed to the heating medium is large and distance traveled by the internal moisture is short.

Usually the air is blown upward but only when the material is wet and dusting will not be serious. A single fan and heat source can be used but ordinarily heat exchangers are located just below the screen when the air is forced up and just above when air is blown down. When several individual fans and heat exchangers are used along the tunnel the drying conditions can be independently controlled at those points.

For example, higher flow rates and temperatures can be used at the front end of the tunnel where constant rate drying takes place and lower flow rates and temperatures can be used farther along where falling rate drying occurs.

Often the length of the dryer can be reduced by reloading the charge in a deeper bed on a second, slower conveyor as drying nears completion. Reloading in a deeper bed is feasible because lower air flows can be used in the falling rate period. Sometimes such reloading is necessary because of product shrinkage as drying progresses.

Since the feed must be in such a physical state that hot air can be blown through it as it is conveyed on a screen, many materials must be pretreated before they can be dried on a screen conveyor. The use of a finned drum dryer as a preformer and predryer has been discussed under drum drying. In addition it may be possible to granulate dry substances, extrude pasty ones, score some filter cakes as they come from a rotary vacuum filter, briquette or pellet powders, or flake some materials on a chilled drum.

The screen conveyor can be loaded and unloaded automatically so labor costs are low. In general this dryer has the advantages and disadvantages

mentioned in the preliminary discussion of continuous and convection dryers.

Many other carriers have been used in tunnel dryers. For example, the charge can be placed on trays which are carried through the tunnel by chains attached to each side and several passes can be made in one tunnel. Some Class III materials can be hung from hooks or draped over rods. Still others, such as veneers, can be carried on roller conveyors. One of the more unusual carriers is a coarse mesh chain into which a pasty charge can be pressed.

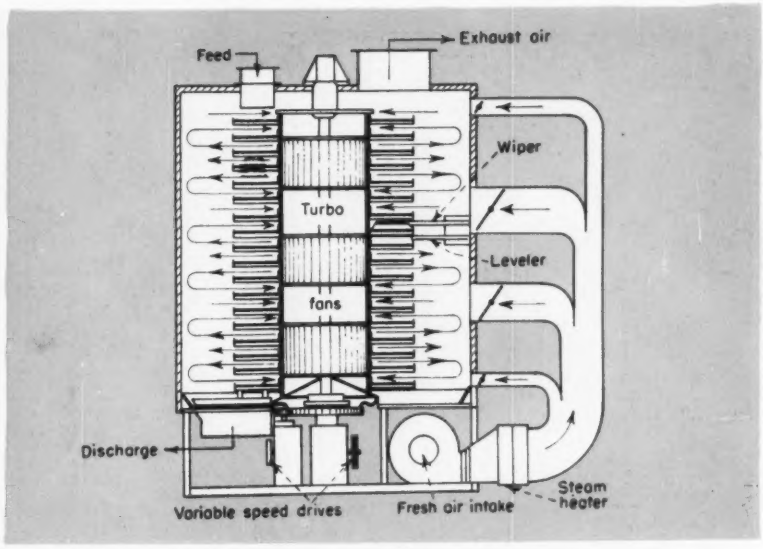
Turbo Dryer

The turbo dryer has gained wide usage since its development less than 30 years ago. Many variations on its basic design have been made in that time, but it still consists essentially of a roughly cylindrical, vertical enclosure with turbine-type fans on a central shaft and rotating annular shelves around those fans.

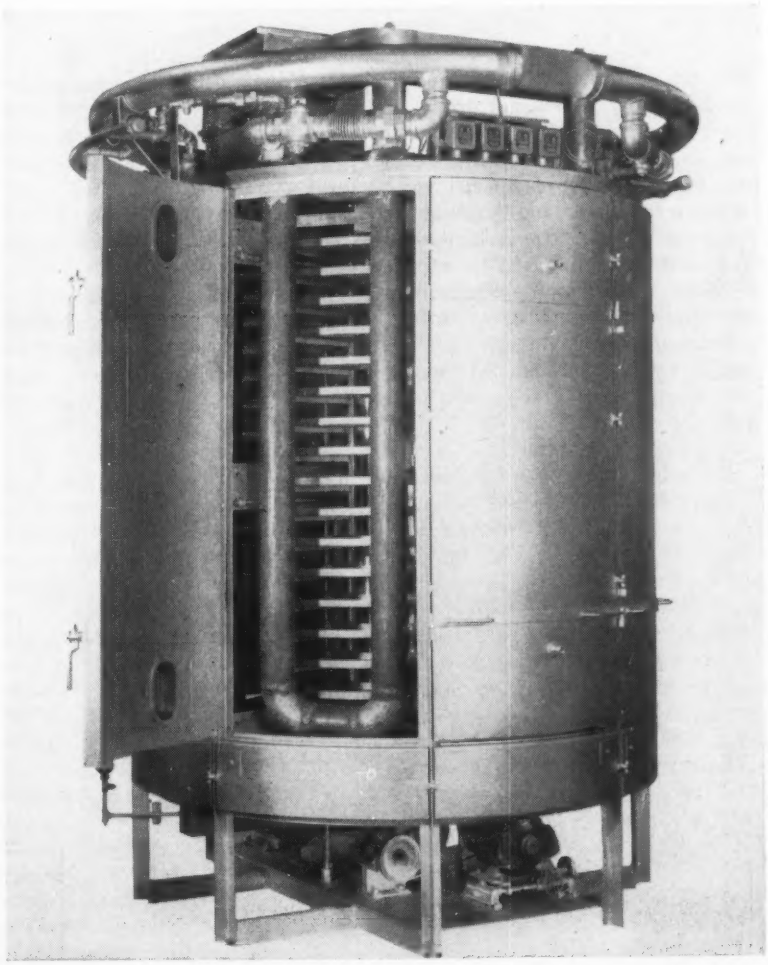
The material to be dried is fed via an opening in the top to the first shelf where it is spread as the shelf rotates. Before that shelf has completed one revolution the material is wiped from it to the one below. There the material is leveled by a stationary arm as the shelf moves slowly by. In this way the charge is passed down through the dryer as it is swept from one tray to the next, leveled and swept on again. At the bottom the product is caught in a hopper and discharged by a conveyor.

The repeated piling and spreading of the material as it passes through the dryer mixes the charge and continually exposes fresh surfaces. Thus a good drying rate and a uniform product are obtained. Attrition usually is slight because the handling is gentle and intermittent.

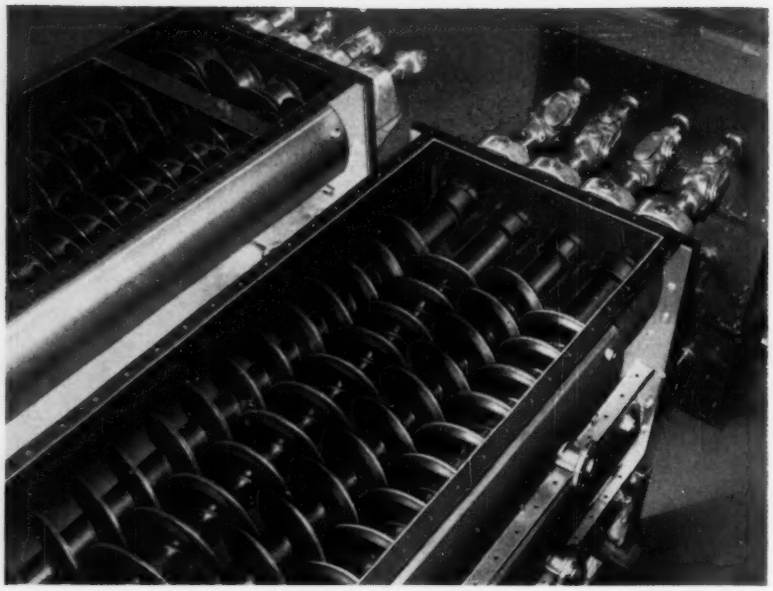
The air flow is from bottom to top, countercurrent to the solids. The fans blow air across the shelves but do not force it through the dryer. Instead the vertical structure acts as a stack. The warm gases pass out at the top and are replaced by fresh air below. A slight negative pressure is maintained within the enclosure and dust and fumes cannot escape to the atmosphere except through the exhaust duct. The fans are so spaced



TURBO dryer with external heating system (Wyssmont)—Fig. 8.



TURBO dryer heats air internally with gas-fired radiant tubes (Wyssmont)—Fig. 9



TROUGH dryer has jacketed screw conveyor (Western Precipitation)—Fig. 10.

that the air is alternately blown outward over the shelves and drawn inward to the center as it passes through the dryer. Usually heat exchangers are located in the peripheral space between the shelves and the enclosure to reheat the air after each outward pass between the shelves.

Good heat efficiency results from the countercurrent flow, internal reheating and low air throughput. Dusting is practically eliminated because the exhaust gases contact wet solids and have a low velocity as they leave the dryer.

Although dusting is no problem in the exhaust stream it can occur within the dryer where air velocities are high. This dust may coat the heat exchangers and reduce heat transfer rate. Therefore the turbo dryer sometimes is equipped with an external heater and ducts to provide heated air several points up the side of the enclosure. (Fig. 8). This dryer can be more easily cleaned than the standard one and, if a portion of the exhaust air is recirculated, its heat efficiency will be nearly as good.

For low temperature drying the inlet air can be dehumidified to lower the wet bulb temperature and if solvent recovery or drying in an inert atmosphere is desired a closed system with complete recirculation can be used. When complete recirculation is used the solvent must be removed from the exhaust stream by condensation, absorption, adsorption or chemical reaction.

A recent development in turbo dryers has been the application of gas-fired radiant heaters (Fig. 9). No air is required. Instead the heat for vaporization is provided by radiation and the circulation of superheated vapors derived from the moisture in the feed. Inert gases may also be used to sweep vapors from the dryer.

The turbo dryer is especially useful in locations with limited floor space because of its vertical construction. A wide range of feed materials from thick slurries to fine powders can be handled. However, fibrous materials which tend to mat, or doughy and sticky materials which hold together during transfer or stick to the transferring mechanism, cannot be dried in the turbo dryer.

Rotary Jacketed Shelf Dryer

The rotary jacketed shelf dryer is an adaptation of the shelf dryer to continuous operation. It has horizontal circular shelves within an enclosure and a shaft which passes down through the center of the shelves. This shaft carries paddles or plows which scrape the material to the outer circumference of one shelf and to the center of the shelf below. Openings at the outer edge of one shelf and the center of the next allow the material to fall from one shelf to another. In this way the material to be dried passes continuously from the top of the dryer to the bottom where it is discharged.

The rotary jacketed shelf dryer is limited in application to relatively free flowing granular materials, such as damp crystals, which can be raked from one side of the shelf to the other. But it is compact and has the usual advantages of a continuous conduction dryer.

Moving-Bed Dryer

The moving-bed dryer has been used primarily for the drying of grain such as wheat and corn. In its simplest form it consists of a heater, fan, duct work, container for the bed, and a screw conveyor for product removal.

The wet material is charged at the top of the bed and the dry product removed at the bottom. The warm air is blown through the bed from bottom to top countercurrent to the solids. Good heat efficiency results because the air leaves the bed at or near the temperature of the entering solids. Several disadvantages are present, though: (1) moisture evaporated near the bottom of the bed may be condensed at the top as the temperature of the air falls, (2) the pressure drop may be excessive, and (3) the capacity is limited.

Sometimes steam tubes are located in the bed itself so as to reheat the rising air. Thus capacity is increased and moisture condensation is decreased. More commonly, however, air inlets and outlets are located throughout the bed so that the path traveled by the drying air is no more than about a foot.

The air inlets usually consist of inverted troughs placed in a horizontal plane through the bed. The hot air passes down around the edges of the troughs and up through the bed to the air outlets which are a similar set of troughs in a horizontal plane above the air inlets. Several sets of these inlets and outlets are placed in the bed and those near the bottom may be provided with cold air to cool the product.

Tower Dryer

The tower dryer is also commonly used for drying grain. The feed is charged in a hopper at the top and moves down the tower by gravity, cascading from one inclined baffle to another. Hot air passing through this curtain of material cleans and dries it. Cold air often is used at the bottom of the tower to cool the product.

Screw, Paddle or Trough Dryers

A screw, paddle or trough conveyor dryer usually consists of a jacketed tube or trough through which the material to be dried is forced to flow. Feed materials, therefore, are limited to those which will not coat the walls and which can be handled by screws, paddles or rabble arms.

Sometimes the rotating members are hollow and heated (Fig. 10). Often, several passes are arranged one above the other so that the discharge from an upper pass becomes a feed for the next lower one. Because several passes can be used a series of drying zones can be set up just as for the vibrating conveyor dryer.

These dryers are of particular value if conveying, solvent recovery or continuous vacuum operation is desired. Some materials, though, may be broken and degraded by the conveying action.

Vibrating Conveyor Dryer

The vibrating conveyor dryer is described by its name. It has an air chamber below a conveying screen and hot air passes up from the chamber through the vibrating screen and the material being conveyed. The air flow is sufficient to impart a fluidizing action to the bed and the drying rate therefore is high.

At air velocities generally employed in this type of equipment, some –80 mesh particles may be carried out in the air stream, but they can be recovered in dust collectors if desired.

The handling action is gentle and little degradation, even of friable materials, occurs. As another advantage, several sections can be operated in series so that the air temperature, air flow rate, bed depth and holdup time can be varied to meet changing drying conditions.

For example, high temperatures and air flow can be used in the constant rate drying section because moisture evaporation holds the particle temperature at the wet bulb point. The drying rate will be high so the conveying action can be fast. Lower temperatures probably will be used in the falling rate section, where the product temperature will approach that of the heating medium. The drying rate will be relatively independent of the air velocity so lower air flow rates can be used. Since the air flow rate will be lower the bed depth can be increased with no increase in pressure drop. Since drying will be slower the hold-up time can be increased.

This dryer has the general characteristics previously discussed for the continuous convection dryer, with feed materials limited to those which can be handled by a vibrating conveyor system.

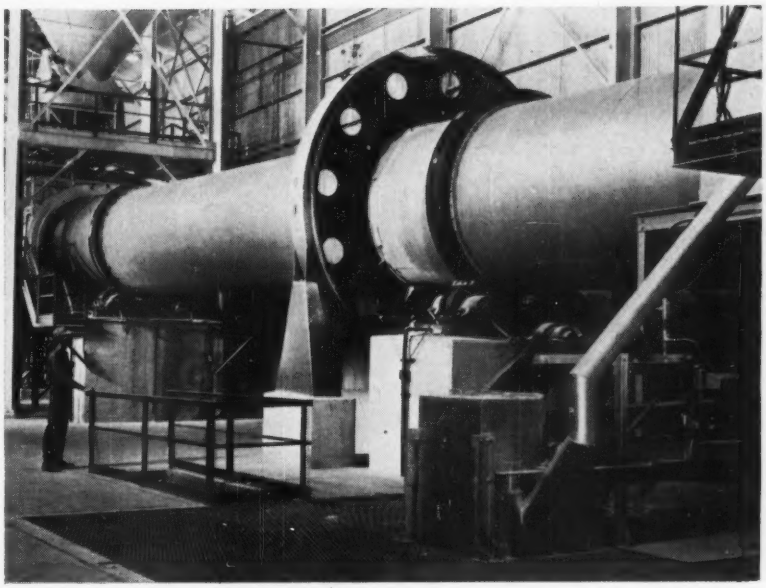
Jacketed Vibrating Conveyor Dryer

A jacketed vibrating conveyor dryer is the conduction counterpart of the vibrating conveyor dryer described previously. It is a series of vibrating conveyors with jacketed carrying surfaces through which heat is transferred to the material being conveyed. Dowtherm, steam, other vapors or hot gases can be used as the heating medium.

One advantage of this dryer is the gentleness of the conveying action. Particles are kept in constant motion yet do not fall any appreciable distance. Breakage and crystal degradation usuall present no problem to the processor.

Another advantage is that the conveying sections can be operated independently of each other. Drying temperature and hold-up time can be separately controlled at each section and several different drying zones can be maintained by automatic or hand control.

For example, a high jacket temperature and rapid conveying can be used during the constant rate period when drying is rapid and the temperature is limited to the solvent's boiling point. This constant rate drying zone can be followed by a section operating at a lower jacket temperature and with a deeper bed. Thus the drying temperature, which approaches that of the jacket during the falling rate period, can be held low and holdup time can be increased.



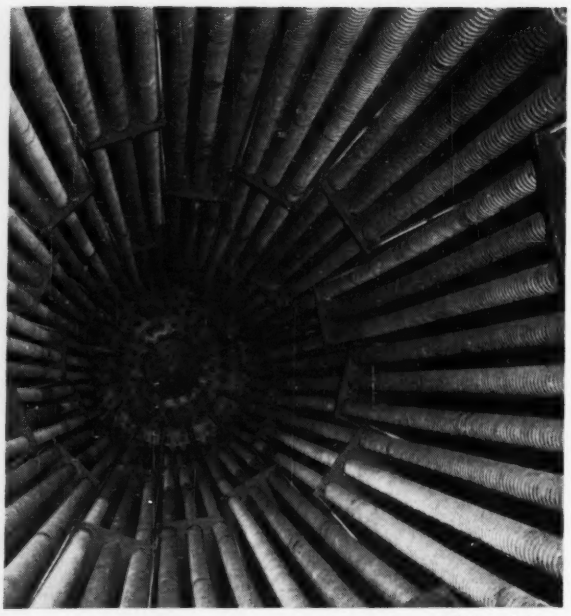
DIRECT ROTARY dryer: chemical processing workhorse (Allis-Chalmers)—Fig. 11.

Rotary Dryers

Direct Rotary Dryer

The direct rotary dryer is one of the work horses of the chemical industry. It consists of a horizontal cylinder in which the heating medium

DIRECT ROTARY dryer disperses solids in the gas stream via saw-toothed lifting flights (Standard Steel)—Fig. 12.



STEAM-TUBE dryer's tubes are finned for additional heat transfer surface (Louisville Drying Machinery)—Fig. 13.

makes direct contact with the charge. Usually the cylinder is rotated and is slightly inclined from the horizontal, so that the load can be made to flow by gravity from the higher to the lower end (Fig. 11).

In some rotary dryers the shell remains stationary and the particles are made to flow by a rotating stirrer. This type of dryer differs from the screw or paddle conveyor described in that it uses convection heat transfer rather than conduction.

Another direct rotary dryer, the DehydrO-Mat, uses a rotating cylinder with lifting flights, but the charge is carried through the dryer by the heating medium instead of gravity. The slope may be either up or down depending upon the throughput desired. In one of the latest models slope is made continuously variable from up to down; while the dryer is in motion, by mounting the drive and trunnion wheels on a single frame which can be tilted at will.

The shell of the direct rotary dryer may be a smooth cylinder in which case the particles are carried up the wall as the cylinder rotates until they tumble back over the load. Still better contact between charge and drying medium can be obtained with lifting flights which carry the material to the top and then shower it down through the air stream (Fig. 12). Usually the flights are so curved that particles are released throughout the overhead arc and a nearly uniform fall across the cylinder cross-section results.

The heating medium can flow concurrent or countercurrent to the solids. Countercurrent flow can produce a low final moisture, but it cannot be used with some materials because the hot inlet gases contact dried product about to be discharged and raises its temperature considerably. When concurrent flow is used the inlet temperature should be as high as possible in order to increase the thermal efficiency. Evaporation of moisture from the wet feed will hold the solids temperature below the wet bulb point during the constant rate period.

A high air velocity is desirable to increase heat transfer rates, but the velocity is limited by the dusting which occurs at the discharge end where the dry particles are smaller and lighter. The DehydrO-Mat design solves this problem by using a larger diameter for the falling rate period than for the constant rate period. A larger capacity in a shorter length results.

The direct rotary dryer is inflexible; sticky and dusty materials are difficult to handle in it; and friable materials are easily broken. Nevertheless, this dryer almost always should be given consideration, for a great deal of experience has shown it to be easy to operate, relatively simple and inexpensive, and to have a high capacity.

Indirect Rotary Dryer

The indirect rotary dryer has an inclined rotating cylinder through which the charge passes without directly contacting the heating medium.

The simplest form consists of a rotating cylinder with an enclosure of brick or steel. The fuel is burned at one end of the enclosure and the combustion products flow around the cylinder in passage to a stack. Sometimes a concentric cylinder is placed within the drying cylinder and the flue gases passed back through this cylinder to utilize more of the heat.

Another type has an external furnace. The combustion products pass through an inner concentric cylinder and then back to hollow flights along the inner wall of the drying cylinder. Still another type has stationary tubes through which hot gases traverse the length of the dryer while material is showered over these tubes by lifting flights along the inner wall of the rotating cylinder.

Most of these dryers have lifting flights to increase the heat transfer surface and to stir the material. Even then the capacity of an indirect rotary dryer is low compared to that of the other rotary dryers, and it is selected only when direct contact between combustion products and the material to be dried cannot be tolerated.

Dusting is of little importance but other typical rotary drying problems may exist. The tumbling and falling action may break crystals and thus degrade the product or the feed may stick to the heater surfaces. Sometimes knockers can be used to loosen stuck material and sometimes dried products can be recirculated with the feed to eliminate the sticking property.

Steam Tube Dryer

The steam tube dryer actually is a type of indirect rotary dryer, but it has been listed separately because its operating characteristics are quite different from those of the indirect rotary listed above.

The steam tubes are arranged so that they run the length of the dryer in one, two or three concentric circles just inside the rotating cylinder to which they are attached. (Fig.13). The large heat transfer surface obtained through the use of these pipes gives the steam tube dryer the highest capacity of all rotary dryers. Often, lifting flights are employed to stir the material being dried. Some heat is transferred by convection as the charge falls from the flights, as well as by conduction and by radiation from the overhead steam tubes.

Sticky materials are especially difficult to handle because they can quite easily be packed behind and between the steam tubes. Usually only one circle of steam tubes is used with sticky materials and is shielded at the feed end where packing would occur.

The steam tube rotaries have high steam generation costs, high drying temperatures and some product degradation from the falling and tumbling action. On the credit side, they have high capacities and, in common with other conduction dryers can provide good thermal efficiency, minimum dusting, minimum contamination, exclusion of undesired gases, and easy solvent recovery.

Direct-Indirect Rotary Dryer

The direct-indirect rotary dryer, in its simplest form, consists of a rotary drying cylinder within a heated enclosure. The latter is connected to the discharge end of the cylinder so that the hot gases can pass from the enclosure through the cylinder, countercurrent to the solids, to the exhaust duct. In this way the hot combustion products first contact the cylinder wall, heat the charge by conduction, and then directly contact the material being dried.

Another form of the direct-indirect rotary consists of two concentric cylinders. The solids are carried through the annular space between the cylinders by flights on both the outside of the inner cylinder and the inside of the outer. The heating medium passes first through the center cylinder and then returns, countercurrently, through the annular space.

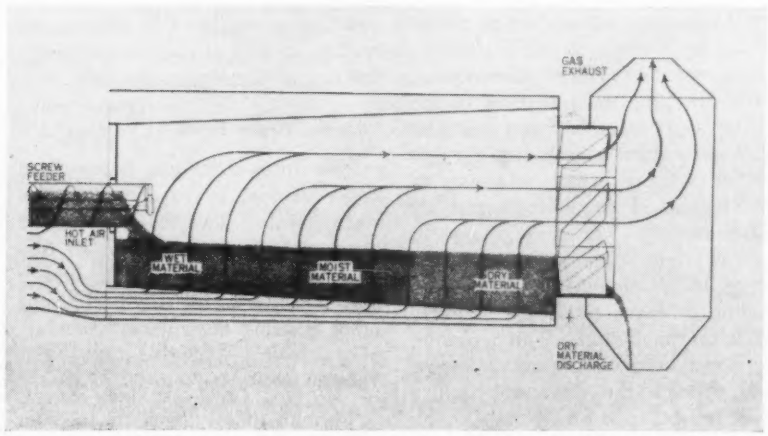
The direct-indirect rotary dryer operates at a higher temperature, is more difficult to clean and is more expensive than the direct, but its heat efficiency and capacity are higher. In other respects it is much like the direct rotary.

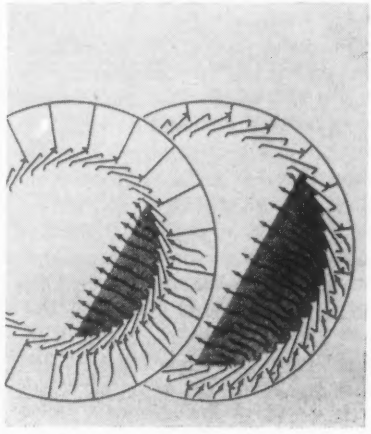
Louver Dryer

Louver dryers are constructed in many forms, but all employ overlapping shelves or louvers to support the charge as it is dried by hot gases which pass between the shelves and through the shallow bed above.

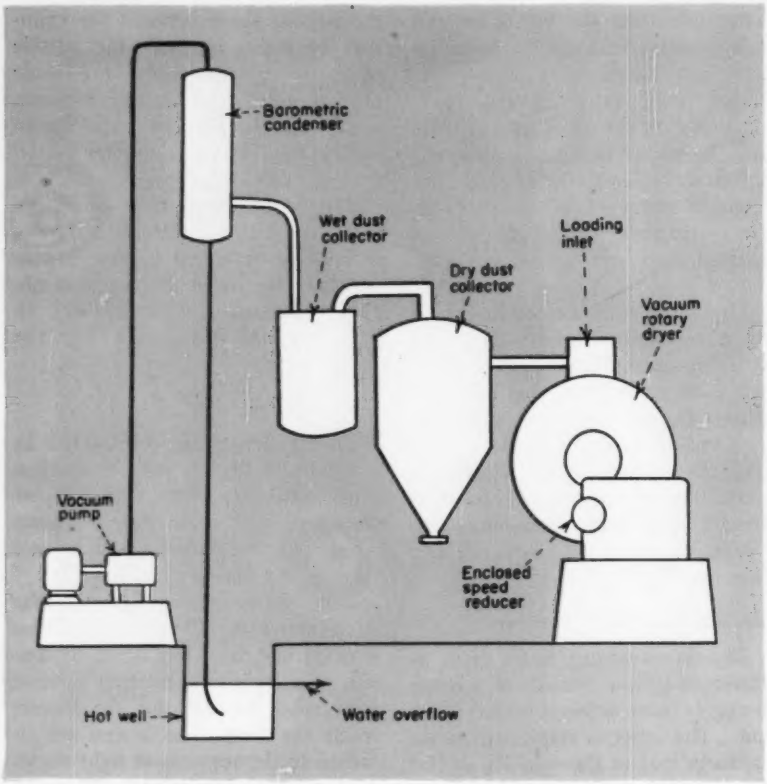
One of the common types is the Roto-Louvre or Pehrson dryer. This is much like the rotary dryer. It consists of a horizontal rotating cylinder with radial supports for the louvers inside the shell. The louvers are attached to the supports at right angles so that they overlap each other and form an inner shell which carries the bed of material to be dried.

The particles in the bed are carried up the side of the inner shell as it rotates and roll back over the bed to new positions. This relatively gentle stirring action produces little particle breakage and is one of the principal reasons for selection of the Roto-Louvre dryer in many cases.





ROTO-LOUVRE dryer employs a sloping bed, and higher air velocity at feed end where it's most needed (Link-Belt)—Fig. 14.



VACUUM ROTARY dryer with dust collectors, barometric leg (Buflovak)—Fig. 15.

Channels are formed by the radial supports between the outer shell and the louvers and hot air is charged only to those channels which are covered by the load as the cylinder rotates. The air flows between the louvers through the drying bed and passes out of the dryer through either the opposite channels, a discharge hood at the end of the dryer, or a duct extending into the middle of the dryer from one end.

The radial supports are longer at the feed end of the dryer than at the discharge end so that the shell formed by the louvers is a truncated cone. This shape serves two purposes: first, the slope from feed to discharge drives the solids through the dryer; and second, more air flows to the bed at the feed end of the dryer where the channels are larger and the bed is shallower (Fig. 14). As a result high air velocity with its high drying rate occurs at the feed or wet end of the dryer where it is desired.

The bed depth is controlled by vanes at the discharge end of the dryer and is maintained sufficiently deep for good heat transfer from the gases to the solids. Good thermal efficiency for a conduction dryer and high capacity result.

Dusting usually is not excessive because the bed itself acts as a dust filter; only the top layer can release fines into the exhaust stream.

An even more compact, and nearly vertical, form of the louver dryer, the Multi-Louvre type, has no resemblance to the rotary dryer. The louvers are mounted on endless chains so that each can pick up a portion of the charge, carry it up the steep slope and spill it completely back over the following louvers before returning to the bottom of the dryer to pick up more material. The particles are carried a short distance through the dryer by a combination screw and paddle conveyor each time they fall back to the bottom. The warm air is drawn between the rising louvers and through the downward spilling bed to the exhaust duct. The air temperature can be controlled in zones across the dryer by means of dampers.

Still another type of louver dryer is similar to the vibrating conveyor dryers. Oscillating louvers are used to convey the solids and the drying medium is drawn up between the louvers through the moving bed.

Vacuum Dryers

For heat sensitive or easily oxidized materials, or where the solvent is to be recovered, a vacuum dryer may be selected. A vacuum dryer can provide good thermal efficiency, solvent recovery, minimum dusting, minimum contamination, and exclusion of undesired gases. However, a vacuum dryer requires vacuum-producing facilities and, if it is to be operated on a continuous or semi-continuous basis, special feed and discharge devices.

As a result, investment, operating and maintenance costs are higher for a vacuum dryer than for the corresponding atmospheric dryer. A vacuum dryer should be selected only if a satisfactory atmospheric dryer cannot be found.

Vacuum Shelf Dryer

The atmospheric shelf dryer is readily converted into a vacuum shelf dryer by fitting the hollow shelves into a heavy casing reinforced by outside ribs. The door is swung on a hinged yoke, fits against a rubber gasket when closed and is held in air-tight place by eyebolts. The vapor passes to a condenser. Any uncondensed vapor and gases go to a vacuum pump.

The temperature may be kept low and may be regulated by altering the vacuum as well as the flow and temperature of the heating medium.

Vacuum Drum Dryer

The drum dryer can be operated under vacuum by encasing it in an air-tight tube. Two receivers for the dried material may be used so that the vacuum in one may be broken and its contents discharged while the other is being filled under vacuum.

Vacuum Rotary Dryer

Vacuum rotary dryers are used for higher production rates than the jack-

eted shelf dryer, but only when the material to be dried can be agitated.

Two different types are in common use. One, usually called the rotary vacuum, has a stationary horizontal cylinder with a rotating stirrer (Fig. 15). The cylinder is jacketed and in larger sizes the cylinder heads, the stirrer shaft and arms are heated too. This type is especially suitable for liquid feeds, for the vigorous stirring tends to break and degrade solids.

The second is often called a rotating vacuum dryer to distinguish it from the first. It consists of a jacketed horizontal rotating cylinder with internal flights. These flights carry the material up the side of the dryer, release it to tumble back over the bed but do not carry any overhead where it can fall back to the bottom. Therefore, particle breakage and dusting are not so prevalent as in the first type. In other respects the vacuum rotary dryers have the characteristics mentioned previously in the general discussion of vacuum dryers.

Cone Dryer

The cone dryer is a variation of the rotating vacuum dryer. It has the shape of two oppositely directed cones on a common base and is rotated about a diameter of this common base. Thus, it is identical with the cone blender in appearance and in its mixing action. The body of the dryer is jacketed and the heating medium is introduced and withdrawn through rotary joints at the trunnion. Solids are charged and discharged through openings at the points of the cone and the vapors are withdrawn through a vacuum line to one of the trunnions. The cone dryer with a glassed-steel inner surface has been found especially suitable for the removal and recovery of acid halides from solid particles.

Vacuum Freeze Dryer

Any vacuum dryer can be used as a vacuum freeze dryer (the vacuum shelf dryer is the most likely candidate) by freezing the charge and controlling the heating medium so that drying occurs by sublimation rather than by vaporization.

Vacuum freeze drying is the slowest, most expensive of all drying methods but it produces the least physical and chemical change. The low temperature inhibits chemical reactions, enzymatic changes, bacteria growth and the loss of volatiles. Since the drying rate is slow, no case-hardening occurs. The frozen solvent holds the solids in position so no foaming or migration of solids can take place. The product remains porous, uniform and can be re-dissolved easily.

Because drying is under vacuum all the advantages previously mentioned hold true.

Combination Dryers

Filter Dryer

The filter dryer is a combination of a continuous rotary vacuum filter and a dryer. The filter is enclosed and hot air supplied to the enclosure is drawn through the cake to dry it.

The filter dryer's use is limited to situations in which filtering is followed by drying and to materials which can be vacuum filtered and have low critical moistures. Its main advantage is that it combines two operations and thus eliminates one piece of equipment.

Centrifugal Dryer

A centrifugal dryer, like the filter dryer, combines two processes in one piece of machinery. The discharge from a continuous centrifugal is blown around the circumference of a short, horizontal cylinder by a blast of hot air; spiral baffles projecting in the cylinder direct the flow towards the discharge end. There the solids leave through an opening in the cylinder wall while the air passes along the cylinder axis into an exhaust housing and then into a dust collector before being discharged.

Application is limited to materials of low critical moisture which are to be centrifuged and dried.

Web or Sheeting Dryers

Sheeting dryers are of many types. One, the cylinder dryer, is classified with the conduction dryers. The others are convection dryers and can be considered as variants of the tunnel dryer.

The cylinder or "can" dryer is used to dry continuous sheets which can be flexed. Paper and textiles are good examples. The cylinder can be heated by hot gases but ordinarily steam is used. The dryer itself may be a single cylinder but usually consists of one or more series of cylinders.

The sheet is looped around the cylinders so that first one side of the sheet and then the other contacts their drying surface. In some cases a belt, which is dried along with the sheet, is used to support the sheet and to hold it against the cylinders. This belt also produces more uniform drying by absorbing spotty excess moisture from the sheet. Warm air jets, directed against the sheet, or infrared heaters may be used to increase the drying capacity.

If drying without tension is desired the festoon or loop dryer can be used. In this dryer the sheeting is draped over parallel rods conveying it through the drying enclosure. In another type, which dries without tension, sheeting is placed on a conveyor which carries it past heated air nozzles within the enclosure.

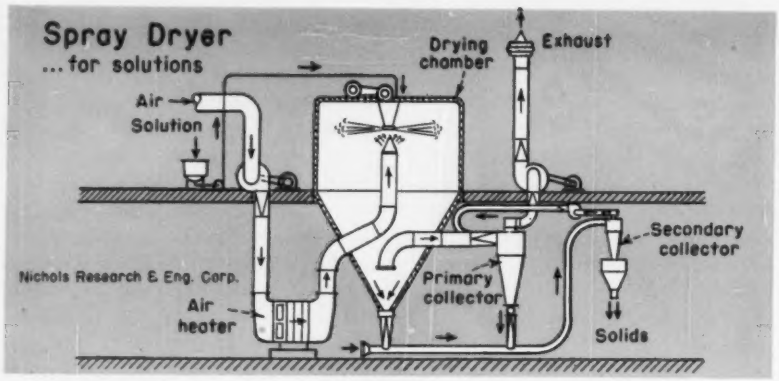
If tension along the sheet can be permitted or is desired, the sheeting can be passed over fixed rolls inside the heat enclosure. Nozzles can be used to direct hot air against the sheeting as it passes by and thus increase the drying rate.

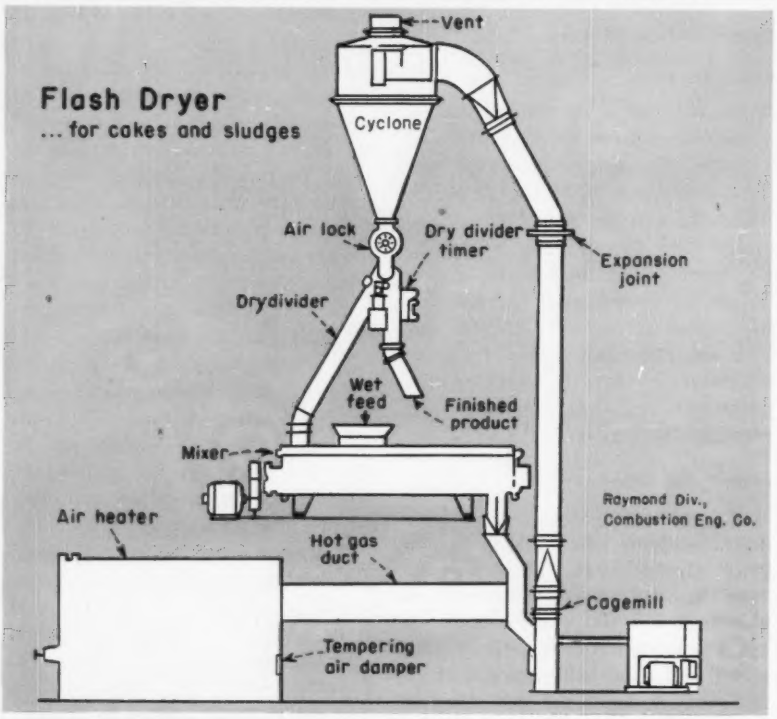
If tension across, as well as along, the sheet is desired the tenter dryer should be selected. The sheet is held at its edges in a horizontal position with clips or pins similar to those of a curtain stretcher. Thus held it may make several passes, one above another, through a drying tunnel. Or it may be passed between a series of drying nozzles which blow air against both sides of the sheet.

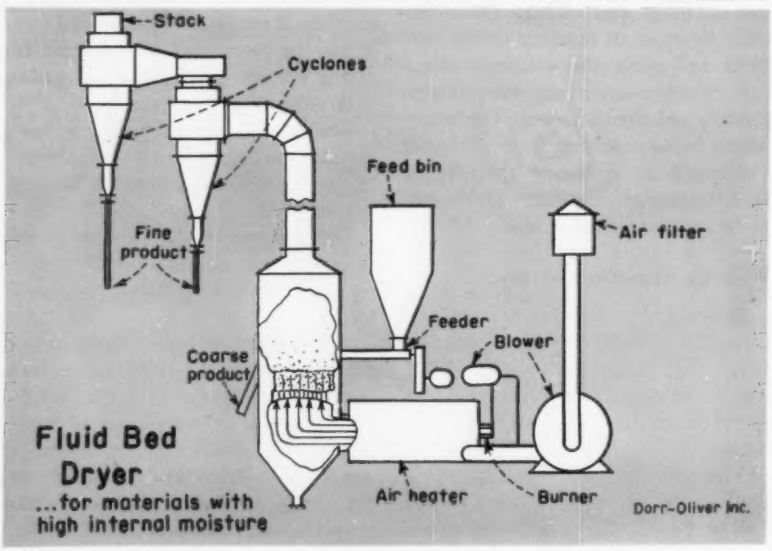
Sometimes a combination dryer employing heating rolls and/or infrared heaters as well as convection heating can be used.

Platen dryers are rather specialized in application and are used where a localized high temperature is called for.

The continuous platen dryer carries the material to be dried on a belt over a heated plate. It is particularly suited to the drying of flat surfaces. The platen dryer may be made in almost any shape and is suited for the drying of bulky objects of odd shapes, as well as flat surfaces.







Suspended Particle Dryers

Spray Dryers

Spray dryers have been known for more than 50 years, but they have come into widespread use only in the last 20. They dry by atomizing the feed in a hot gas (usually air). The spray may be produced by a two-fluid nozzle, a high-pressure nozzle, or a rotating disk.

Few comparative data have been published on these three methods. However, the two-fluid nozzle has a reputation for non-uniform atomization and inefficiency at high capacities, and has been confined primarily to pilot plant work where its low operating pressure may be an advantage.

The high-pressure nozzle is especially suited for use in countercurrent dryers because its spray can be directed into the gas stream better than can the rotating disk's. However, high-pressure nozzles tend to be inflexible in capacity, and several must be installed in a dryer in order to vary the feed rate without changing the operating pressure and, thereby, the particle size. They erode easily, and can become plugged. Thus, rotating disks, which are rugged and flexible, have become common in the chemical industry. Disks can handle thicker suspensions than the nozzles and their feed rates can be varied somewhat without markedly changing the particle size.

Despite the considerations listed above, the selection of an atomizer usually involves tests; and that atomizer is chosen which provides satisfactory particle size with the least power consumption. Ordinarily as small a particle size as possible, consistent with product quality, is desired because a smaller drying chamber with its lower investment cost can be used.

The gas flow can be concurrent, countercurrent, or a combination of both. Concurrent flow is especially suitable for heat-sensitive materials since the high initial rate of evaporation maintains a solids temperature near the wet-bulb point and rapidly cools the surrounding gases. The high allowable inlet-air temperature and the low product discharge temperature make thermal efficiency relatively easy to attain. However, extremely low

moisture contents cannot be obtained because the product leaves the drying chamber in contact with the wet exhaust gases. Also, the bulk density of the product is low because the vapors escaping rapidly from the drying droplet tend to increase the particle size and decrease its density. In many cases hollow spheres are produced by the expanding vapors.

Countercurrent flow can be used when a dryer product and/or a higher bulk density is desired. The particles usually are solid spheres or granules, but in some cases agglomeration occurs as small dry particles are held in the countercurrent air stream and are struck by larger wet particles. The product is less uniform and less beadlike in appearance than that from a concurrent spray dryer.

Bulk density, one of the more important product characteristics, can be increased by reducing the particle size after production through use of grinding machinery or through attrition within the dryer itself. It can be increased by lowering the inlet air temperature, by selecting countercurrent gas flow instead of concurrent, and by choosing an atomizer which will produce fine droplets and/or a wide range in size distribution. It can be increased by deaerating the liquid, by increasing the temperature of the feed, by increasing the solids concentration (hydrophilic materials are exceptions here), or by adding certain materials to the feed as salt is added to detergents.

The spray droplets dry within a few seconds. They may be collected in the bottom of the drying chamber to avoid attrition or they can be carried out with the exhaust gas and collected in cyclones. Loss of fine particles may be a problem. Often a baghouse, a Cottrell precipitator, or a wet scrubber is used to remove the final traces of product from the exit gas. A portion of the feed may be used as the liquid in a wet scrubber. In this way, the feed can be preconcentrated and preheated before it enters the drying chamber. If fresh liquid is used in the scrubber, it can be added to the feed as it becomes concentrated.

Spray dryers are especially suited for high-volume production of heat-sensitive materials with low critical moisture contents. The spray droplets have a large total surface area and evaporation occurs so rapidly that a low temperature is maintained even in a high-temperature gas stream. In addition, the time of exposure to a high temperature is extremely short.

The dried particles are small and roughly spherical in shape. They can be redissolved quite easily and are free-flowing and easy to handle. Another advantage of the spray dryer is that high-temperature inlet air can be used. This tends to increase thermal efficiency.

However, the spray dryers have several disadvantages. They are rather inflexible in respect to both feed material and capacity. The particle size of the product cannot be changed readily, and the product bulk density is low. Recovery of the product from exhaust streams or removal of particles stuck to the walls of the drying chamber often is a problem. The initial investment in drying equipment and auxiliaries is higher than for most convection equipment, especially at low capacities.

Flash Dryer

The flash, or pneumatic conveyor, dryer is the Class II counterpart of the spray dryer. The solids are dispersed in the heating medium, conveyed vertically a short distance and separated from the gas phase. Drying occurs rapidly and many heat-sensitive materials can be safely handled.

Particulate solids can be dropped off the end of the conveyor directly into the rising stream of hot gases. Other solids such as filter cakes and sludges must be disintegrated before they can be carried by a gas stream. Still others of larger particle size must be pulverized. Warm air is circulated through the disintegrator or the pulverizer to pick up the solids as they become sufficiently broken down in size to be conveyed.

The conveying ducts may be rectangular or circular, uniform or diverging along their length. The divergent conveying duct allows the heavier incompletely dried particles to fall back for further drying.

The solids usually are separated from the gas phase in cyclones. Product size classifications can be accomplished at this point, and the oversize wet particles can be separated and returned to the mill.

In many cases a portion of the dried product is recirculated with the wet feed to condition it for proper dispersion in the gas phase. A time valve can be used to divide the dried material into product and recirculation streams and a mixer (for example, a pug mill) is used to contact the dry return stream with the wet feed. If the feed is exceptionally wet it may be necessary to operate two or more drying stages in series. Increased efficiency and decreased dusting also result from recirculation and series operation.

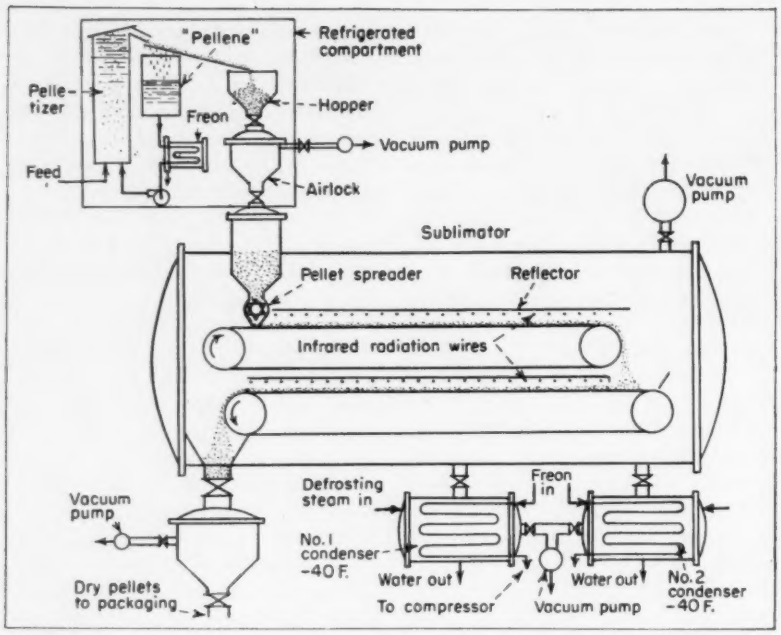
The flash dryer is limited to materials that can be broken down in size without loss of value or ease of processing, which are not abrasive, which will not stick to the duct walls, and which do not have high internal moisture contents. At high capacity, though, it is one of the least expensive dryers and is particularly applicable when size reduction as well as drying is desired, or when the feed is a heat sensitive material with low internal moisture.

Fluid Bed Dryer

The fluid bed dryer complements the flash dryer in that it can be used with materials of high internal moisture which cannot be dried by the flash dryer. It consists of a vertical cylinder with a perforated bottom plate through which hot gases are blown at a rate sufficient to fluidize the bed of particles.

The material to be dried is dropped into the bed from a conveyor or rotary feeder and may be removed automatically via an overflow pipe or wier. If large particles and lumps tend to accumulate in the bottom of the bed, a bottom discharge is used. Fines are carried overhead and recovered in cyclones or other gas-solids separators. Thus size separation can be carried out with the fluid bed as it dries.

Since the product is withdrawn directly from the bed the dryer is operated at all times at a low moisture content. Since the fresh feed, as it enters, rapidly becomes coated and mixed with dry material, wet or sticky charges usually can be handled without recirculating any of the dried product. However, it is ordinarily



INFRARED dryer adapted for vacuum freeze work (Proctor & Schwartz)—Fig. 16.

necessary to retain some dried material at each shutdown to reform the bed.

The intimate and turbulent contact between the hot gases and solids produces rapid drying, and the gentle but thorough mixing of the fluidized state maintains a uniform temperature throughout the bed. The dryer is simple in construction, compact, easy to control and operate; but its feed is limited to materials less than about $\frac{3}{8}$ in. in size. Often two beds are operated in series, the second acting as a heat exchanger to cool the product prior to packaging and to preheat the incoming drying air.

Special Dryers

Dielectric Dryer

The dielectric dryer heats deep within an object without transferring heat through the surface.

It consists essentially of two electrodes across which a high frequency alternating voltage is impressed. When a wet material is placed in an electric field between these electrodes heat is generated within the material by the rapidly alternating potential. Thus, bulky objects with poor heat transfer characteristics can be heated more uniformly and more rapidly.

The dielectric dryer is the most expensive of all dryers both in first cost and in operating cost. Therefore its use is limited to experimental work and to certain applications where its peculiar characteristics are sufficiently advantageous to overcome its cost.

Infrared Dryer

Infrared dryers can be built in an almost infinite variety of forms. In fact, practically any dryer can be converted to the use of radiant heat, but most commonly the material to be dried is conveyed past the infrared source in an enclosure (Fig. 16). Steam- or gas-heated metal panels, gas-heated refractories or electrical resistors may be used as a radiation source. Gas-heated refractories are the cheapest to operate but they may create an explosion hazard in some instances. Electrical resistors are the most convenient but the most costly to use.

Because generation of infrared heat is more expensive than the generation of convection heat, infrared dryers have been limited to those applications in which certain special characteristics are important. For example, infrared dryers are easy to move and inexpensive to fabricate so they often are used in experimental or temporary set-ups. Since they require little space and dry surface moisture rapidly, they are sometimes used as auxiliaries to increase the capacities of other dryers.

Heat can be directed to particular spots or sections of a solid object, so it is possible to avoid the trouble and expense of heating the entire object if a portion is to be dried.

At the same time, the infrared dryer preferentially heats the exposed surface of an object rather than its bulk. It is quite commonly used for the drying and baking of painted surfaces. This same characteristic limits the use of infrared to the drying of surfaces, sheets, films and small particles.

ACKNOWLEDGEMENTS

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Part II: Dryer Selection and Cost

Look for this second side of CE's report next month. Authors Lapple and Clark will apply Part I's methods and equipment to drying problems—will show you how to deal with them and what it will cost.

CE REFRESHER

Chemical Engineering Fundamentals

General Considerations in Reactor Design—II

T. E. CORRIGAN and E. F. YOUNG, Olin Mathieson Chemical Corp., Brandenburg, Ky.

In last month's installment (*Chem. Eng.*, Sept. 1955, p. 203) we listed four interacting factors that affect the selection and engineering design of chemical reactors. These are:

- The reacting system (liquid phase, gas phase, etc.).
- The reactor (batch, tubular, etc.).
- The type of operation (isothermal, adiabatic).
- The type of reaction (parallel, series, etc.).

Our next two installments will be devoted to a more detailed consideration of the types of reactions and how they affect reactor design. And in December we plan to work out a design problem.

Types of Reactions

As we stated last month, the major types of chemical reactions are:

1. Simple.
2. Parallel.
3. Series.
4. Complex series.
5. Reversible.

Most physical chemistry and chemical engineering texts on the subject of chemical kinetics emphasize the case in which only a single reaction takes place at a time (Group 1 above). Although the case of simple reactions is the most convenient type to illustrate some of the elementary principles, such as order of reaction, it is the type which occurs least frequently in industry.

In most processes there is more than one reaction taking place at a time. The types found most frequently in commercial reactors are parallel, series, complex series and reversible reactions. However, all of the basic principles that apply to simple reactions also apply to the other types.

Simple Reactions

In this discussion we will use the term "simple reaction" to mean the case where only one reaction takes place in the reactor. This is not to be confused with the term "simple order reaction" which was used previously to indicate reactions in which the order of reaction is the same as the number of molecules indicated in the over-all stoichiometric equation.

The most common simple reactions are those indicated by the following equations:

$$A \rightarrow R$$
$$A + B \rightarrow R$$
$$A \rightarrow R + S$$
$$A + B \rightarrow R + S$$
$$2A \rightarrow R$$
$$A \rightarrow 2R$$

Let us consider the effects of changes in some of the major process variables such as temperature, pressure, backmixing and reactant ratio on some of these reactions.

Reaction of A Going to R

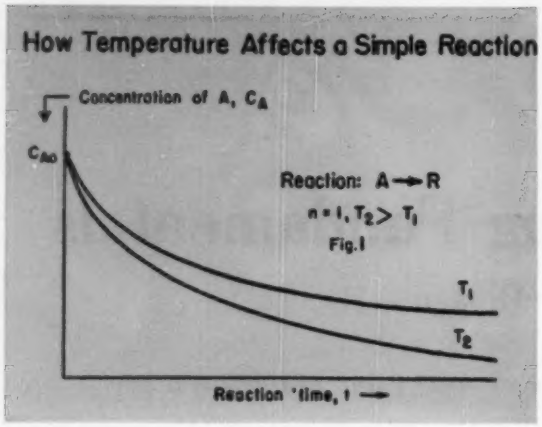
The reaction of A going to R is the simplest known and represents a molecular rearrangement reaction. The basic rate equation for this reaction has the following form:

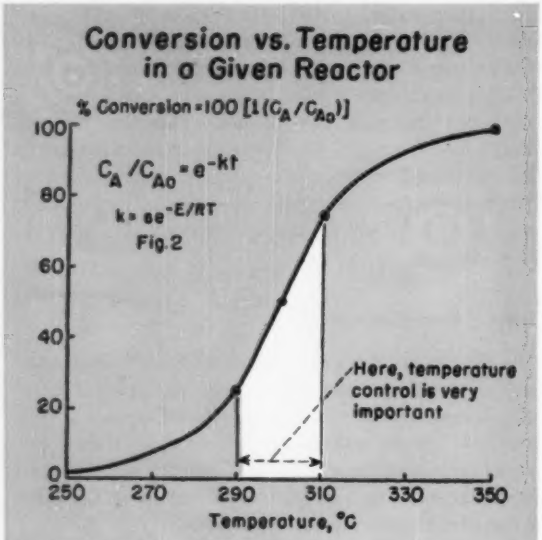
$$-dC_A/dt = kC_A^n \qquad (1)$$

where n is the order of reaction. Although n is usually greater than zero, it can either be an integer or a frac-

Nomenclature (Consistent Units)

A, B	Reactants
C	Concentration of
d	Differential operator
e	2.7183
E	Activation energy
F	Feed rate
k, k_c, k_p	Rate constant, based on concentrations, based on partial pressures
n	Order of a reaction
n	Number of moles
p	Equilibrium partial pressure of
R	Universal gas constant
R, S	Products
s	Frequency factor for molecules colliding
t	Time
T	Absolute temperature
V	Volume
x	Degree of conversion
y	Mole fraction in gas phase
π	Total pressure





Assuming that $t = 5$; $E = 46{,}300$; $s = e^{36.4}$; and $R = 1.987$:

°C	°K	RT	E/RT	ln k
250	523	1,040	44.5	−5.9
290	563	1,120	41.4	−2.8
300	573	1,140	40.6	−2.0
310	583	1,160	39.9	−1.3
350	623	1,240	37.4	1.2

°C	k	$5k$	$e^{-5k} = C_A/C_{Ao}$	% Conversion
250	0.0034	0.017	0.98	<2
290	0.061	0.31	0.73	27
300	0.14	0.70	0.50	50
310	0.27	1.45	0.23	75
350	3.3	16.5	0.00+	99.9

tion. The most common values are 0 (zero order), 1 (first order) and a fraction between zero and one.

For the case where n is equal to one, the rate equation is integrated this way:

$$-dC_A/dt = kC_A \qquad dC_A/C_A = -k\,dt$$

$$\int_{C_{Ao}}^{C_A} dC_A/C_A = -k\int_o^t dt$$

$$\ln (C_A/C_{Ao}) = -kt \quad \text{or} \quad C_A = C_{Ao}e^{-kt} \qquad (2)$$

Effect of Temperature

The basic rate equations of kinetics (see Eq. (1) for example) are defined only in terms of concentration and time. The fundamental variable temperature does not appear directly in the equation. Effect of temperature on the rate is expressed in its effect on the constant k.

There is a great variation of the reaction constant, k, with temperature. Almost always, we can express the value through the Arrhenius equation,

$$k = se^{-E/RT} \qquad (3)$$

Substituting this expression for k into the first order rate equation, Eq. (2), gives:

$$C_A = C_{Ao}e^{-bt} \qquad (4)$$

where $b = s\,e^{-E/RT}$

We can use Eq. (4) to estimate the effect of temperature on conversion. Percent conversion can be expressed as $[1 - (C_A/C_{Ao})]\,100$. Therefore,

$$\% \text{ Conversion} = 100(1 - e^{-bt})$$

and the effect of temperature on a reaction can be shown graphically as a parameter on a plot of concentration vs. time. Fig. 1 is such a plot with T_2 representing the higher temperature.

A plot of percent conversion vs. temperature for a given contact time (or reactor size in a flow process) gives us a better picture of the effect of temperature. In Fig. 2 we show a plot of percent conversion vs. temperature for the hypothetical case of the reaction of A going to R where the rate equation is

$$-dC_A/dt = kC_A$$

and

$$k = 10^{16.7}e^{-46{,}300/RT}$$

We have also assumed a reaction time, t, equal to five.

Note in Fig. 2, that as we approach 250 C. there is practically no reaction. Between 250 and 300 C., the conversion jumps to almost 75%. If the reaction takes place in the temperature range between 290 and 310 C., a very slight change in temperature will have a large effect on conversion. This shows the importance of temperature control for reactions that must take place in the zone represented by the clear area in Fig. 2.

Of course, the ideal case would be for the reaction to take place in the region at higher temperatures than T_2 where the effect of temperature again becomes small. In many reactions this upper temperature region is not reached because the product decomposes or unwarranted side reactions lower the yield. If this happens we no longer have a simple reaction but a complex one instead.

Effect of Pressure

The effect of pressure on a reaction of the type A

going to R depends on whether the reaction is liquid phase or gas phase.

In the liquid phase the effect of pressure is not significant if both A and R are relatively nonvolatile. If A is fairly volatile, higher pressures would favor the reaction only in that they would keep A in the liquid phase and allow higher temperatures to be used. If R is volatile and A is nonvolatile, high pressures would retard the reaction by keeping the product in the liquid phase. These effects are indirect. Since most liquids are noncompressible, there is no direct effect of pressure on reaction rate.

The effect of pressure on the reaction of A going to R is important if the reaction takes place in the gas phase. The basic rate equation is based on concentration and in the gas phase the concentration is a function of pressure. The effect of pressure depends on the order of reaction (value of n). Therefore, we'll discuss the cases of first order, second order and fractional order separately.

Pressure and First-Order Reactions

The basic rate equation written in terms of concentration is:

$$-dC_A/dt = k_c C_A$$

Since the partial pressure of a component in a gas mixture is a measure of concentration, the equation can also be expressed in terms of partial pressure. To convert the equation from concentration terms to partial pressure terms we use the definition of concentration, $C_A = n_A/V$; and the gas law, $p_A V = n_A RT$. Therefore, we can write

$$n_A/V = p_A/RT$$

and the rate equation becomes

$$-d(n_A/V)/dt = (k_c/RT)p_A$$

or

$$-dp_A/dt = k_p p_A$$

where $k_p = k_c/RT$.

By analogy with the concentration equation, the integrated form of this equation is

$$p_A = p_{Ao}e^{-bt/RT}$$

where again $b = se^{-E/RT}$. However, since $p_A = \pi y_A$ (where y is the mole fraction in the gas phase and π is the total pressure, we can also write the equation in mole fraction terms

$$y_A = y_{Ao}e^{-bt/RT}$$

For a given reactor volume the degree of conversion will be the same but more mass of material can be charged into the given volume as the reaction pressure increases.

Pressure When the Order Is Not One

If the reaction of A going to R is either higher order or fractional order, the effect of pressure will be quite different than it would be for the first order reaction. As a basis for comparison let's examine the effect of pressure for the cases where the order of reaction, n, equals 0.5 and 2.

When the order of reaction is 0.5,

$$-dC_A/dt = k_c C_A^{0.5}$$

or,

$$-dp_A/dt = k_p p_A^{0.5}$$

$$p_A^{0.5} = p_{Ao}^{0.5} - 2kt$$

$$\pi^{0.5} y_A^{0.5} = \pi^{0.5} y_{Ao}^{0.5} - 2k_p t$$

This can be worked into

$$(y_A/y_{Ao})^{0.5} = 1 - [(2kpt)/(\pi y_{Ao})^{0.5}]$$

From this equation we can see that for a given feed concentration, y_{Ao}, and contact time, t, the term y_A/y_{Ao} will increase as pressure increases. Therefore, the percent conversion will show the opposite effect and will decrease as pressure increases.

Pressure and Second-Order Reactions

Let's consider now the case where the reaction is second order.

$$-dC_A/dt = k_c C_A^2$$

or,

$$dp_A/dt = -k_p p_A^2$$

$$\int_{p_{Ao}}^{p_A} dp_A/p_A^2 = -k_p \int_o^t dt$$

$$\int_{p_{Ao}}^{p_A} p_A^{-2}\, dp_A = -k_p \int_o^t dt$$

Working through the integration, we get the following equation:

$$1/p_A = (1/p_{Ao}) + k_p t$$

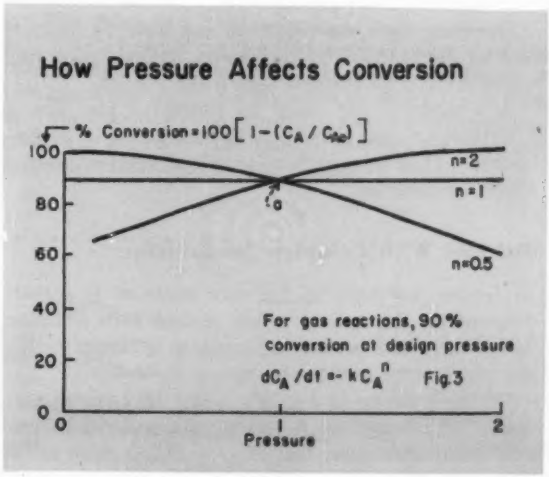
but $p_A = \pi y_A$, and $p_{Ao} = \pi y_{Ao}$ and if the feed is pure A, $y_{Ao} = 1.0$. Then,

$$1/\pi y_A = k_p t/\pi$$

$$y_A = 1/(1 + \pi k_p t)$$

Since percent conversion equals 100 $(1 - y_A)$, the percent conversion increases as the total pressure increases.

We have summarized in Fig. 3 the effect of pressure



on the reaction of A going to R in the gas phase. Percent conversion in a given reactor is plotted against total pressure. Point a is the percent conversion for a first-order reaction for a given contact time, temperature and pressure. The three lines on the plot show the effect of pressure on a reaction of first order, second and one-half order.

For first order, the conversion is the same at all pressures. For the second-order reaction which would have the same conversion at reference point a, the conversion starts out lower at less pressure and increases passing through point a to higher conversion at a higher pressure.

The curve of the one-half order reaction is the reverse of that for the second-order reaction.

Effect of Backmixing on a Reaction

The effect of backmixing in a flow reactor is an important factor in kinetics and reactor design. And it has not been given sufficient attention either in textbooks or in technical literature. Backmixing has a profound effect on the size of a reactor required for a desired conversion in the case of simple reactions. Also, it has a great effect on product distribution as well as size in the case of complex reactions.

The basic differential form of the equation for the reaction of A going to R is

$$-dC_A/dt = kC_A^n$$

and this form is fundamental whether the reaction takes place in a batch reactor, a longitudinal flow reactor or a stirred tank reactor. However, the integral form of the equation is quite different.

Flow Reactors

The basic assumption for the longitudinal flow reactor is that the reacting mass flows through the reactor in an undisturbed plug of material. The time that it takes for this hypothetical plug of matter to flow through the reactor is the same as the contact time in a batch reactor. For this reason the same integral equations that hold for a batch reactor will also be true for a longitudinal flow reactor.

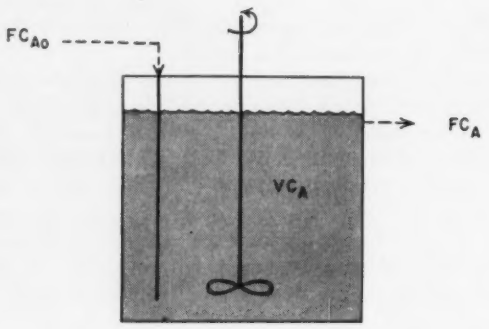
However, these equations do not hold for reactors such as stirred tanks, packed towers, baffled tanks, etc., where there is backmixing within the reactor.

As a matter of fact, since the concept of plug flow is a hypothetical one, there is some backmixing in all flow reactors. That is, even tubular or coil reactors are not 100% longitudinal.

Reactors With Complete Backmixing

The integral form of the rate equation is entirely different for the case of a flow reactor with complete backmixing. The backmixing equation is derived from a material balance over the reactor.

We have shown in Fig. 4 a sketch of a stirred tank reactor of volume, V. A steady state material balance over this reactor shows that $FC_{A_o} - FC_A$ is equal to the



amount of A reacted in a unit time; but the amount of A reacted in unit time equals kC_AV. Therefore,

$$FC_{A_o} - FC_A = kC_AV \qquad (5)$$

where V = the reactor volume; F = the rate of feed and the rate of take-off; C_{A_o} = the concentration of A in the feed; C_A = the concentration of A in the take-off; and N_A = the number of moles of A in the reactor.

If we divide Eq. (5) by F,

$$C_{A_o} - C_A = k(V/F)C_A$$
$$C_{A_o} = k(V/F)C_A + C_A$$
$$C_{A_o} = C_A[k(V/F) + 1]$$
$$C_A = C_{A_o}/[k(V/F) + 1]$$

Here V/F is equal to the ratio of the reactor volume to feed rate and is equivalent to the effective holding time, t.

The equation for a reactor with complete backmixing can also be expressed as

$$C_A = C_{A_o}/(kt + 1) \qquad (6)$$

where t is the holding time.

Backmixing and Order of Reaction

Using this background on the effect of backmixing on reactors with simple reactions, we will continue next month and show how backmixing affects fractional-order and second-order reactions. Tables and charts will summarize the over-all effect.

Then we plan to discuss the effect of reactant ratio on reactor design and the effect of backmixing on the reaction of A and B going to R and S.

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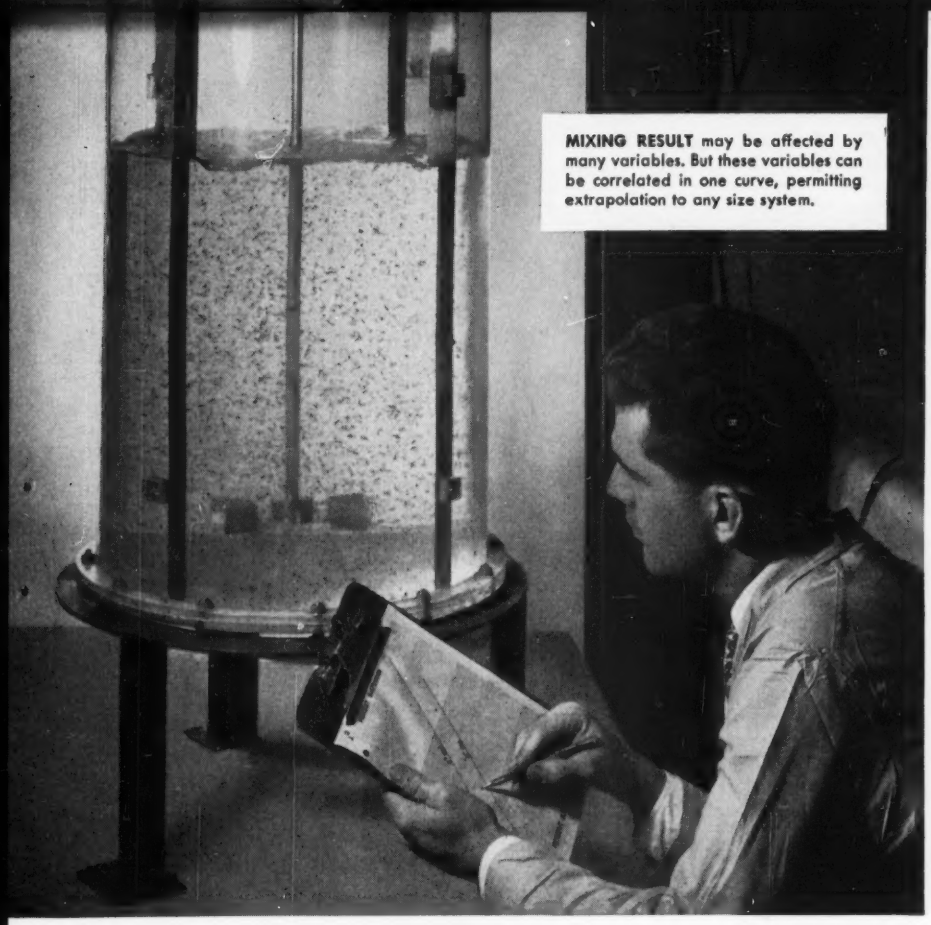

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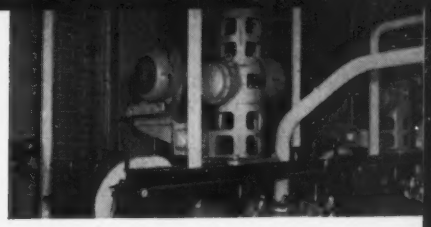

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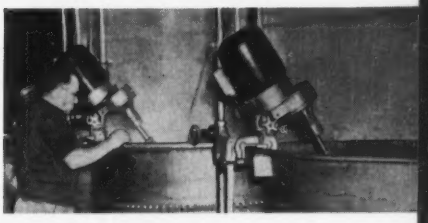

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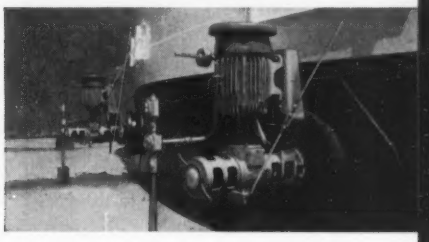

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You can *guarantee* that this won't happen to you—simply by specifying LIGHTNIN Mixers for all your fluid mixing operations. Here's why:

Every LIGHTNIN Mixer you buy is unconditionally guaranteed to do the job for which it is recommended. When you decide to mix with LIGHTNINS, you automatically relieve yourself of all responsibility for success of the installation.

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Get these helpful facts on mixing: cost-cutting ideas on mixer selection; best type of vessel; installation and operating hints; full description of LIGHTNIN Mixers. Free—no obligation. Just check data you want, tear out and mail to us today with your name and company address.

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- ☐ B-107 Mixing Data Sheet
- ☐ B-108 Portable Mixers (electric and air driven)
- ☐ B-109 Condensed Catalog (complete line)
- ☐ B-111 LIGHTNIN Rotary Mechanical Seals

MIXING EQUIPMENT Co., Inc., 128-k Mt. Read Blvd., Rochester 11, N. Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 10, Ont.

★ Winner of July Contest

Reflux Control for Batch Stills

D. E. Mack

Research Dept., Pigment Color Div., Imperial Paper & Color Corp., Glens Falls, N. Y.

We were recently confronted with the problem of automatically controlling a 1,500 gal. still which operates batchwise for solvent recovery. We devised what we feel is a cheap, flexible, and foolproof automatic control method. Although it is now used on a binary system, it could be used also to control a multicomponent system merely by adjusting the controls between fractions. The equipment we installed eliminates the need for a complex reflux splitter and automatically compensates for varying liquid composition without requiring a continuously varying reflux.

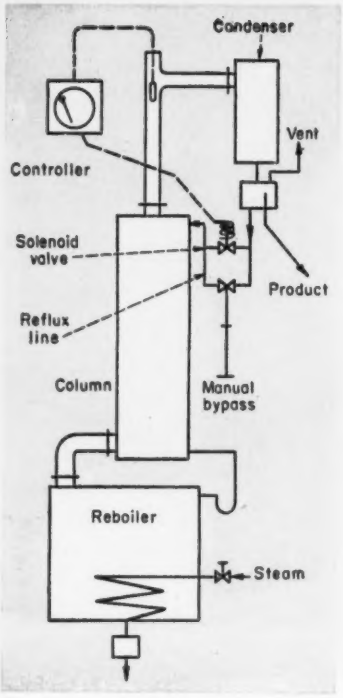
At the condenser outlet a glass overflow box was installed, arranged with high and low standpipes. The low standpipe was connected to the reflux line and the high standpipe to the product receiver. Next, a solenoid valve was put in the reflux line and then bypassed by a manually controlled valve. A temperature recorder with control contacts was installed in the vapor line to the condenser. This controller actuates the solenoid valve, closing it at the set low temperature and opening it at the high.

In operation the high temperature is set slightly above the boiling point of the solvent at the desired purity, while the low temperature is set slightly below. (Our still operates on a temperature differential of about 4° to give 95-99% acetone).

To operate, the steam pressure in the still reboiler is set to give a reasonable condensate rate as observed in the overflow box. From then on the still takes care of itself, alternating between total reflux and total draw-off. When the vapor temperature goes up to the high temperature setting, the solenoid opens and puts the still on total reflux. When the vapor temperature goes down to the low setting, the solenoid closes and puts the still again on total draw-off. This process repeats itself until there is so little solvent left in the still that the vapor temperature, even on total reflux, will not descend to the low setting.

The manually controlled bypass around the solenoid can be used to temper the operation of the solenoid. By opening the bypass to furnish a small but steady stream of reflux, the still will operate without making use of the solenoid until the manually set reflux ratio needs to be increased. At that time the solenoid takes over automatically. The product composition varies within a cycle, but the average composition for a given pair of temperature control settings is very constant.

The cost of the extra equipment needed to make the still automatic (temperature recorder-controller and solenoid valve) was only about $235.



★ Winner of A ast Contest:

No Problem in On-Off Control of Gas Burner After Simple Pressure Regulator Change

As winner of the August Plant Notebook Contest, this article has earned a prize of $50 in cash for David E. Morris, chemical engineer, Mallinckrodt Chemical Works, St. Louis, Mo. His idea enabled him to substitute an inexpensive solenoid valve for motor-operated valves usually used to prevent flashbacks in this type of control.

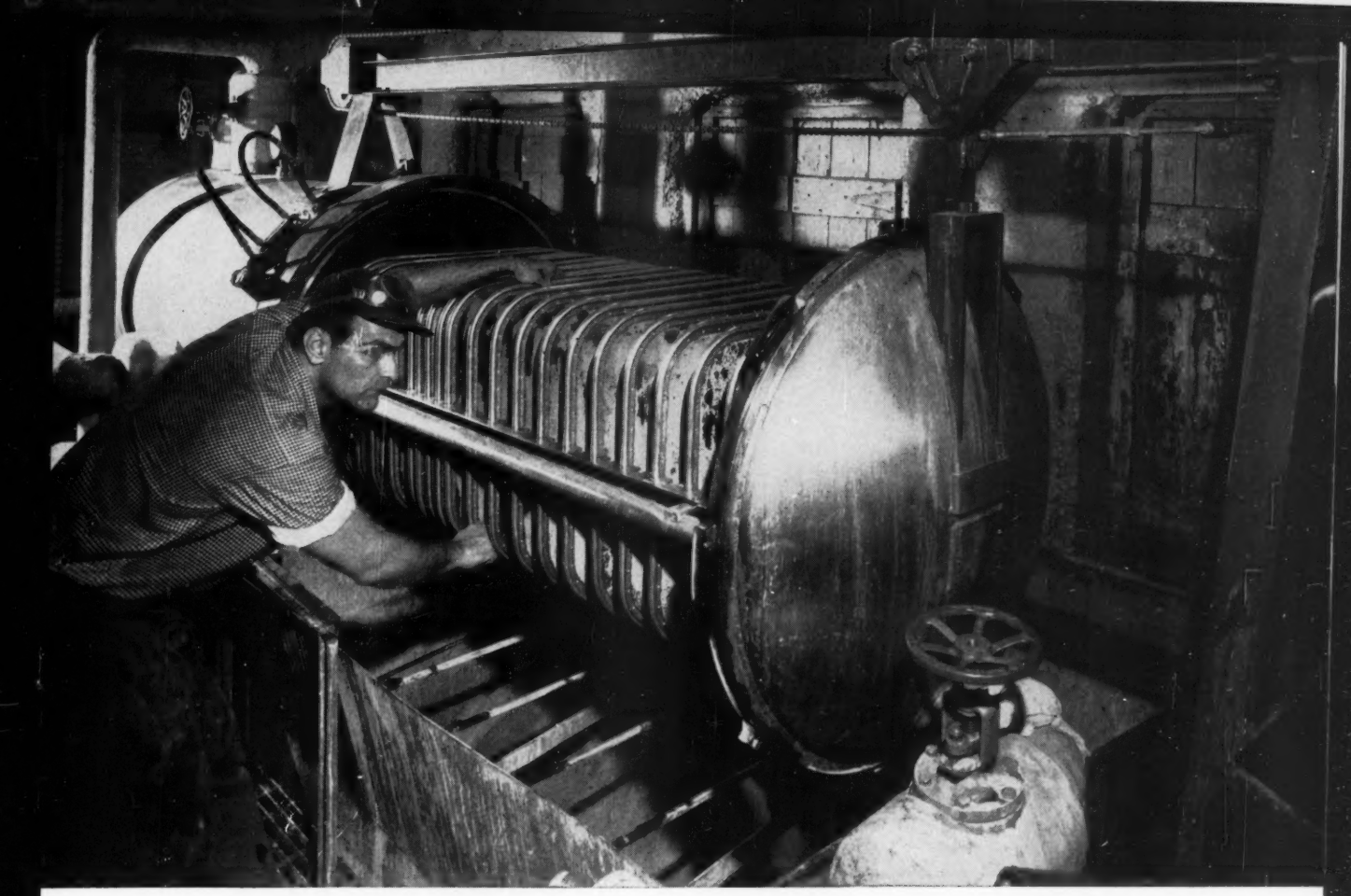
$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for the Plant Notebook.

Each month's winner will be announced in the issue of the second following month, and published the third following month.

$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article which will then be awarded an additional $100 prize.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at regular space rates ($10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.



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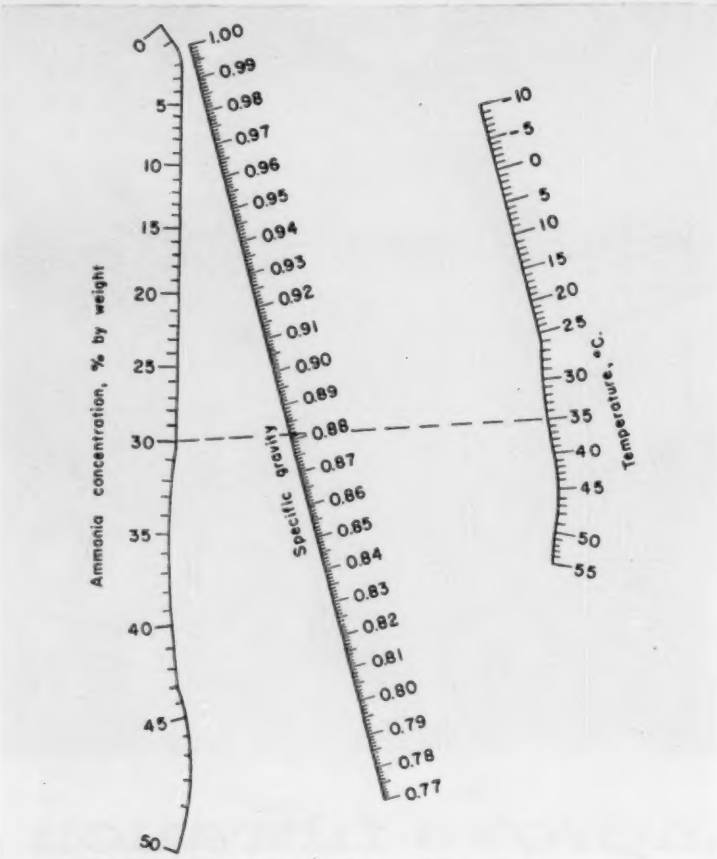


Chart Gives Aqueous Ammonia Densities

A. M. P. Tans

Central Laboratory, Staatsmynen in Limburg, Geleen, Netherlands

The nomograph above gives the specific gravities of aqueous ammonia solutions at various temperatures and concentrations. It was drawn using the data of Mittasch et al[1] and of Gillespie.[2] The chart was then checked at a large number of points, comparing its results with the interpolated values of experimental data. The largest observed deviation was 0.2%, and the mean deviation 0.1%.

As an example of use, what is the specific gravity of a 30% by weight solution of ammonia at 35°C.? The chart shows 0.8818 (see dotted line), whereas the experimental value is 0.8820.

In checking the nomograph I plotted the specific gravity ρ against the temperature T at several different concentrations and found that each of these constant-temperature lines was practically a straight line. Each such line could be expressed by an equation of the type:

$$(\rho)_c = aT + b \qquad (1)$$

where a and b are constants. The slope of these lines decreased with decreasing concentration. Therefore, I evaluated the constants and plotted each of them against concentration C to determine whether they could be related in a simple way to the concentration. By neglecting the concentrations below 5%, which showed too much deviation, I found that both the plot of a vs. C, and the plot of b vs. C again produced straight lines, which could be expressed as equations of the same form as Eq. (1).

By substituting the values of a and b so obtained in Eq. (1) the following equation resulted, expressing the specific gravity of ammonia solutions in terms of temperature T, in °C. and concentration C,

$$\rho = 1.001 - (1.512 \times 10^{-5}\, T + 3\,219 \times 10^{-3})\, C - 19.4 \times 10^{-6}\, T \qquad (2)$$

Eq. (2) holds for concentrations from 5 to 50% and up to 50°C. It was tested for validity and the mean deviation of calculated from experimental values was found to be 0.5%, with a maximum deviation, for concentrations of 10% and lower, of 0.9%.

REFERENCES

1. Mittasch, A., E. Kuss and H. Schluter, Z. *Anorg. Chem.*, **159**, 18, 24 (1927).
2. Gillespie, "International Crit. Tables," 3, 59.

Sampling Air by Vacuum From Auto Manifold

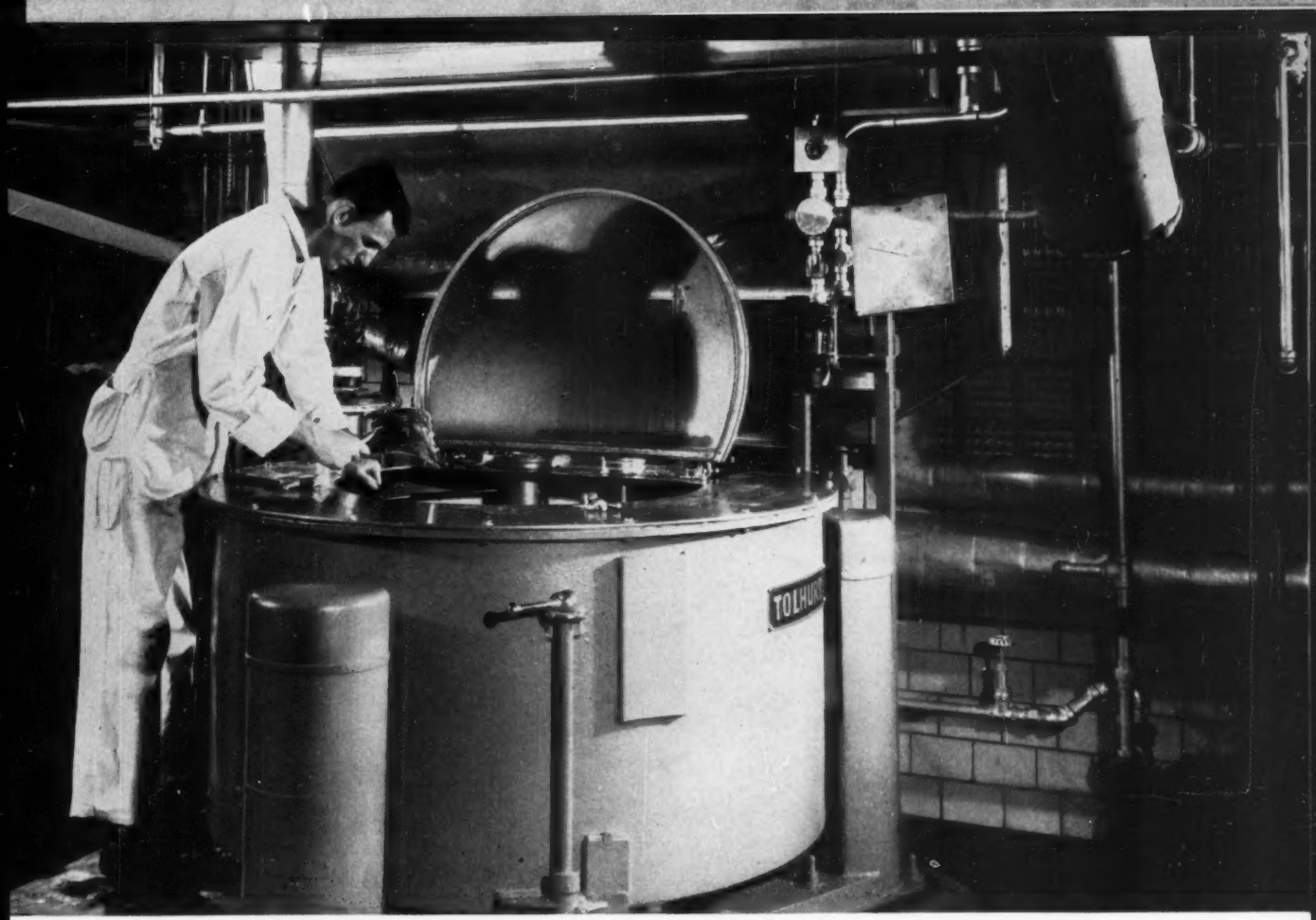
Aaron J. White

Research Dept., Lithium Corp. of America, Minneapolis, Minn.

During the pleasant days of fall it may be hard to recall how cold a winter can be—but fall is the time to prepare for frigid weather ahead. Plants in cold climates, therefore, may find this idea one that they can adapt to their own use when the temperature begins to drop. Even without cold weather, it is a convenience.

Our problem was to take periodic field samples of air to test for chlorine. It is usually inconvenient and cumbersome to use either a dry-cell electric sampling pump, or a hand-operated vacuum pump for gas analysis in the field. This is especially true in cold and inclement weather when, for example, the leather plunger of a laboratory vacuum-pressure pump may become frozen.

One of our manufacturing processes liberates free chlorine. Since the plant is adjacent to residential areas, it is necessary to ascertain the chlorine content of the air in these areas. For this, we absorb



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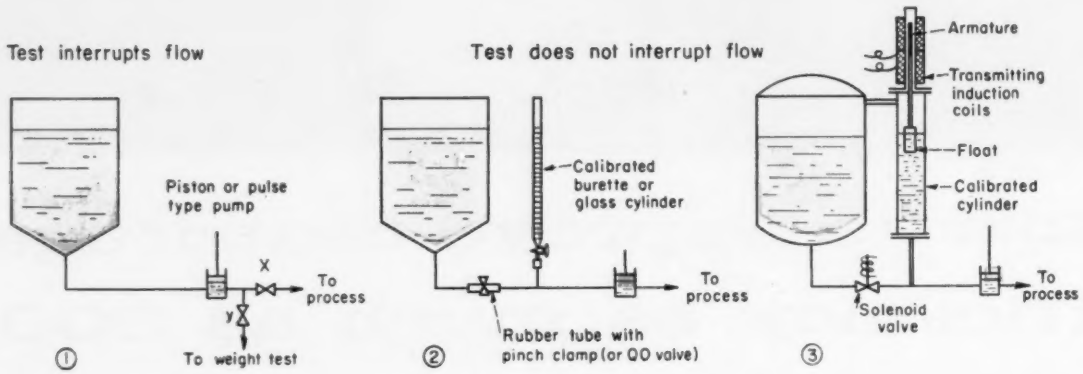
chlorine from the air by o-toluidine solution, getting a colorimetric change which shows chlorine concentration by comparison with color standards.

Our winter temperatures may run as low as −30°F., so it is very convenient to use a company station wagon as the mobile laboratory for these tests. Also the station wagon, being equipped with a vacuum-operated windshield wiper, was easily equipped to provide vacuum for drawing in the air sample. (If the wiper had been electric, teeing into the main manifold would have served just as well.)

As it was, we cut into the rubber hose supplying the wipers from the manifold vacuum booster. (Modern cars with vacuum wipers are generally equipped with a booster pump to maintain constant vacuum while idling or accelerating.) In the break we inserted a tee connection with a ¼-in. brass needle valve installed in the side branch and out of the way under the dash. A 10-ft. length of ¼-in. I.D. vacuum tubing was attached to the valve, for connection to the sampling equipment when it is in use.

The sampler has a second needle valve for adjusting the air-flow rate, and a glass manometer-flowmeter which was calibrated against a wet test meter. Small Erlenmeyer flasks either side of the manometer serve as traps in case any of the colored water in the manometer should carry over. Air can be drawn into the system two ways via a tee. First, it is drawn in through a water bubbler bottle (¾ x 6-in. side-arm tube) to set the flow rate. Then the water bubbler is cut out with a pinch clamp and the sample is drawn in via a 10-ft. length of rubber tubing stuck out the car window, through a second bubbler containing the test solution.

Obviously, this method is equally useful in any type of analysis where gas is drawn through a test solution and a color-change reaction takes place.



Quick Check for Feed Pumps

R. H. Braunlich

Research & Development Div., American Viscose Corp., Marcus Hook, Pa.

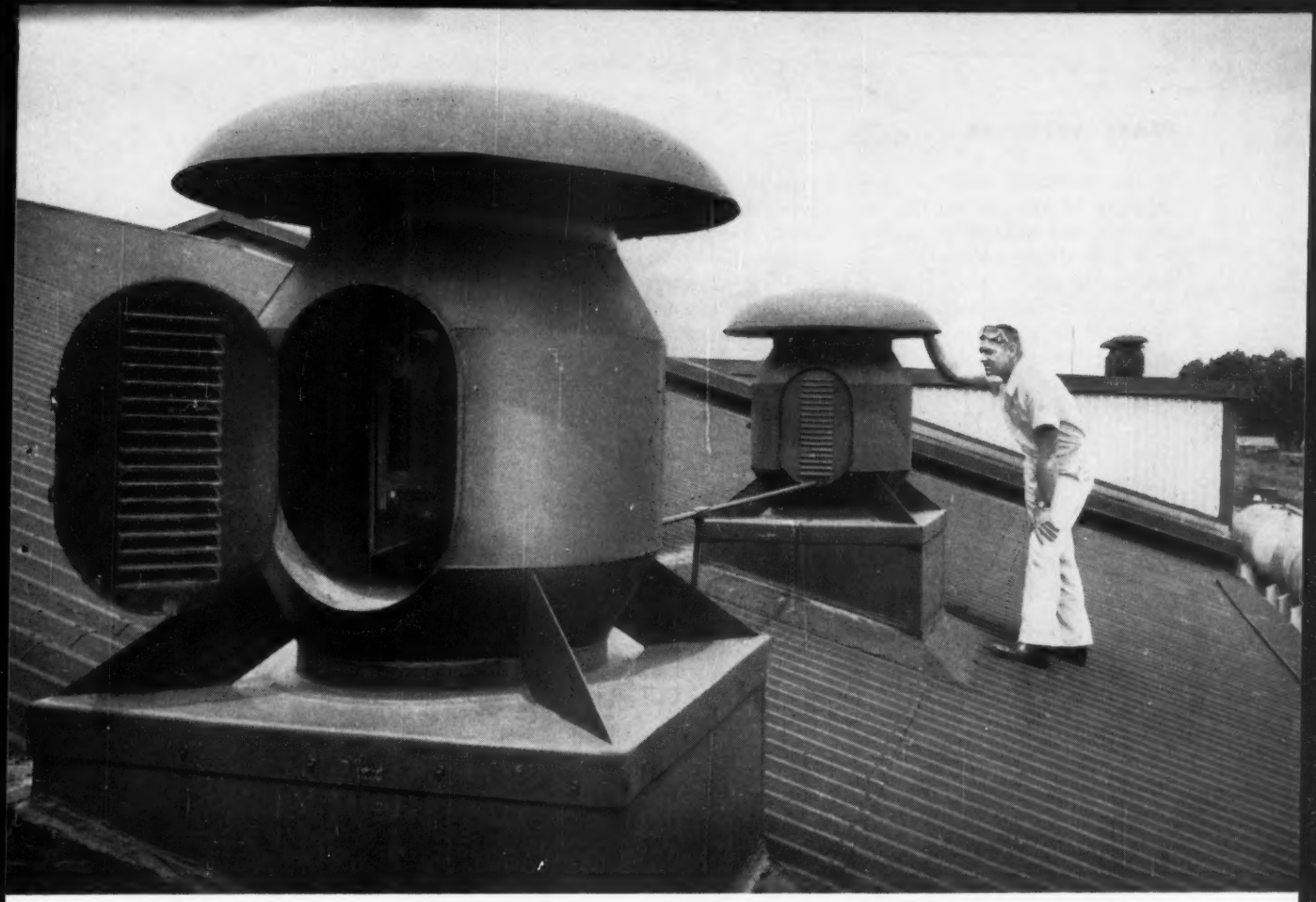
Sketched above are three ways to check the delivery of piston or pulse type pumps which are often used to meter and inject small streams of clear liquids, liquid-liquid dispersions and liquid-solid dispersions. To insure constant delivery it is usually necessary to make frequent flow-rate checks. This is commonly done as in Sketch 1 by stopping the pump, closing valve x to the process, and opening valve y to a container which can be weighed. Then the pump is started and a test quantity run out. This not only interrupts the process, but may result in error if normal delivery is against considerable pressure.

Sketch 2 shows a simple way of avoiding these objections, which also makes it unnecessary to collect and handle a sample of the injectant. Here a calibrated glass cylinder is teed into the delivery line from the supply vessel ahead of the pump. If the delivery rate is small, this can be an ordinary laboratory burette. If the supply is under pressure, of course, then a top connection to the tank is needed.

Liquid will stand in the burette at the same level as in the tank. To run a test the tank is cut out with a pinch clamp or quick-opening valve, so that the pump supply now comes only from the measuring burette.

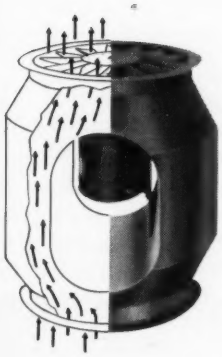
An unskilled operator can easily measure the time for the meniscus to drop between two well-marked levels. He can even read volume per stroke without difficulty if the pump is not operated faster than 100 strokes per min. Non-uniform delivery per stroke will show that the pump check valves are operating improperly.

Sketch 3 is a modification of the method of Sketch 2 that can be used if it should be desired to check pump operation from a remote location. Here the dropping level



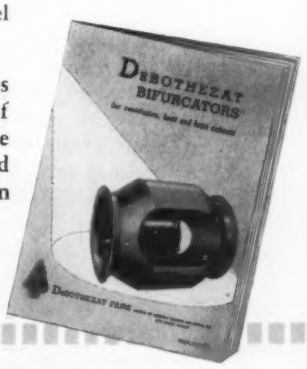
CHAMBER PROTECTS MOTOR FROM FUMES

. . . *minimizes fan maintenance*



The Bifurcator Roof Ventilator shields its fan motor from the destructive rush of hot or corrosive fumes. Note how the unit is built into a split housing and how the motor is mounted safely in its through-ventilated chamber. Destructive fumes bypass the chamber, leaving the motor unharmed. So there's never any need to replace fume-damaged motor parts or wiring. What's more, the motor always stays clean. It's easy to inspect . . . easy to get at for routine service. Just open the louver panel and there's the motor in its roomy chamber.

Installation costs are lower, too. The compact Bifurcator unit comes fully assembled . . . is installed in one piece. It's designed for easy roof curb mounting. No special platforms or supports. Furthermore, the Bifurcator can be used with or without a duct system. It can be furnished of, or coated with, corrosion-resistant materials. Fan wheels up to 48" in diameter. Send for new bulletin.



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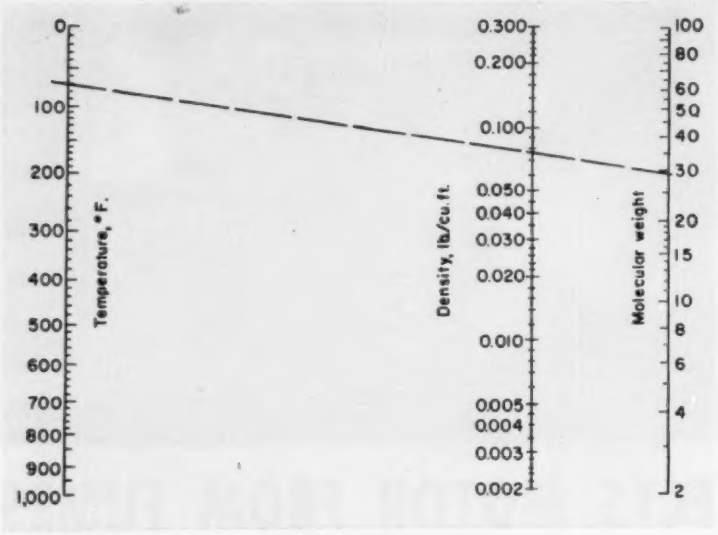
in the calibrated metal or glass tube can be followed remotely by any of several methods for remote level indication. For instance, a float can be used to move an armature in a divided inductance coil connected to a similar coil in a receiving recorder. A solenoid valve operated from the remote location can be used to cut out the main supply tank for the test. An even more advanced system would be to operate the solenoid valve periodically by means of a timer, and rig an alarm system which would be actuated if the interval between start and stop impulses for a fixed level change did not correspond to a predetermined time lapse.



Ideal Gas Density by Nomograph

Om P. Kharbanda

Research Dept., Simon-Carves Ltd., Stockport, England

By a simple manipulation of the ideal gas law, it is possible to development an expression for the density of an ideal gas at 1 atm., in terms of its temperature and molecular weight. The nomograph above is based on this expression. For moderate pressures other than 1 atm., and when the ideal gas law applies, the density value at 1 atm. multiplied by the absolute pressure in atmospheres will give the density at the pressure in question.

The expression is obtained as follows. The ideal gas law can be written for 1 mole of gas as:

$$PV = RT \qquad (1)$$

where P is pressure in atm.; V is molal volume in cu. ft./lb-mole; T is temperature in °R.; and R the gas constant is expressed as 0.729 (atm.) (cu. ft)/(lb.-mole) (°R.). If M is the molecular weight of the gas, then the density in cu. ft./lb. can be represented by:

$$D = M/V = MP/RT \qquad (2)$$

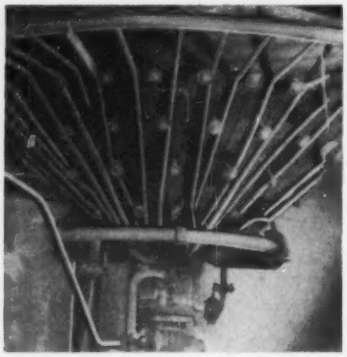
which, in the units chosen, becomes:

$$D = MP/0.729T \qquad (3)$$

Most common gases at 1 atm. conform closely to the ideal gas law. Therefore, at $P = 1$ atm.:

$$D = M/0.729T \qquad (4)$$

This is the equation solved by the nomograph which, however, is marked in °F., rather than °R. As an example, what is the density of air at 70°F. and 1 atm. pressure? Connect 70 on the temperature scale with 29 (mole wt. of air) on the molecular waight scale, and read 0.075 lb./cu. ft. on the density scale.



Heating Coil for Conical Tank Bottom

R. A. Duckworth

Chief Engineer, F. W. Berk & Co., Ltd., Stratford, England

In the November 1954 Plant Notebook, Grossel and D'Aulerio described one method of heating a conical tank bottom by steam coils. Here is another method which we used on our main storage tank for molten sulfur, used to feed two contact sulfuric acid plants.

This bottom was originally jacketed, while the main portion of the tank was heated with internal coils. However, such a jacket rates as a pressure vessel under the British Factory Act and so must be covered by insurance, and submitted for periodic inspection and test. This latter stipulation could not be met, however, since with two plants being supplied with sulfur, there would never be a time when both were down for overhaul at the same time.

The photograph clearly shows the new coil arrangement. Two headers around the cone are connected by a series of ½-in. pipes placed between the staybolts of the old jacket. A small jacket was fabricated around the outlet valve. The whole was then covered with plastic 85% magnesia insulating cement, keyed onto wire netting clipped to the staybolts.

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—E. R. Weidlein, President
Mellon Institute, Pittsburgh
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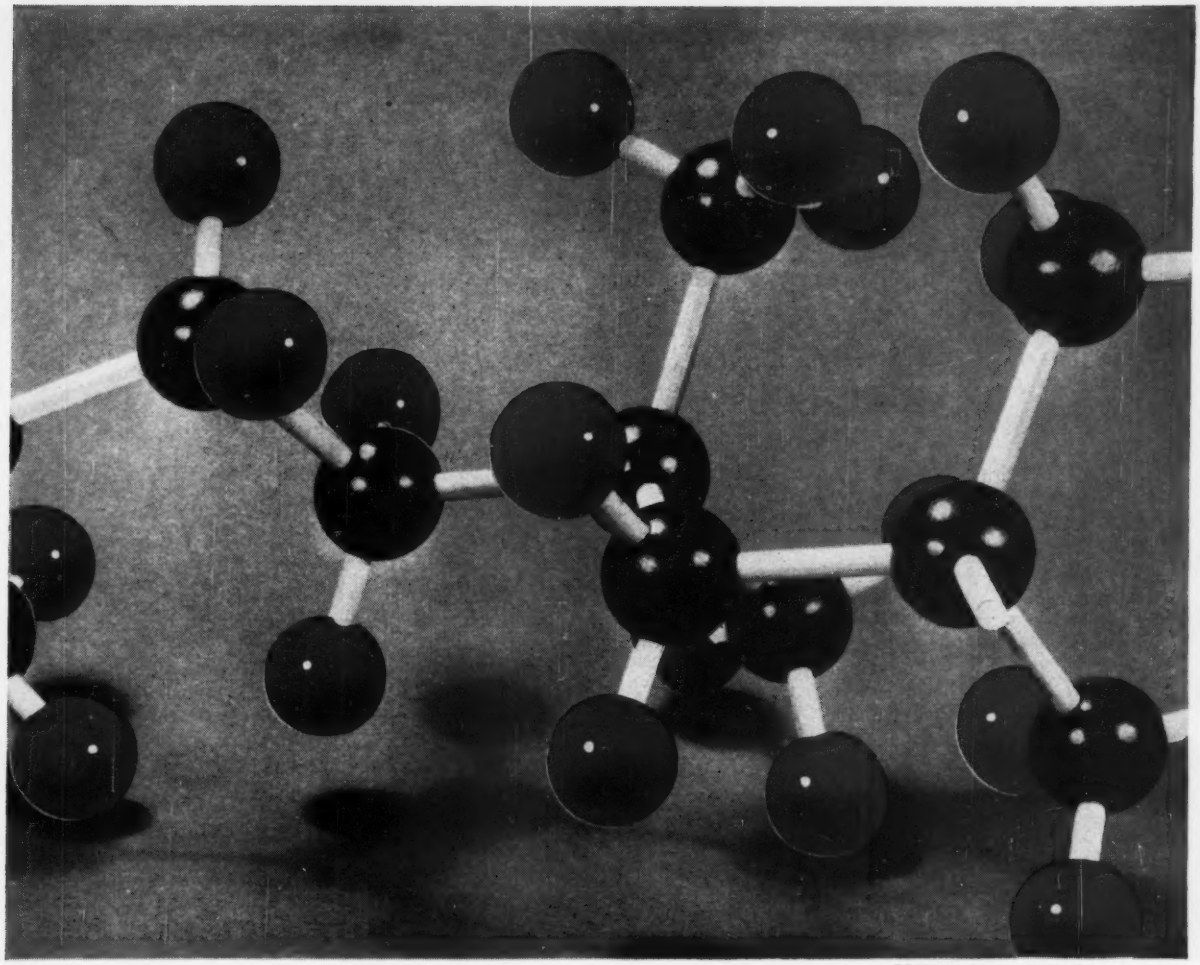

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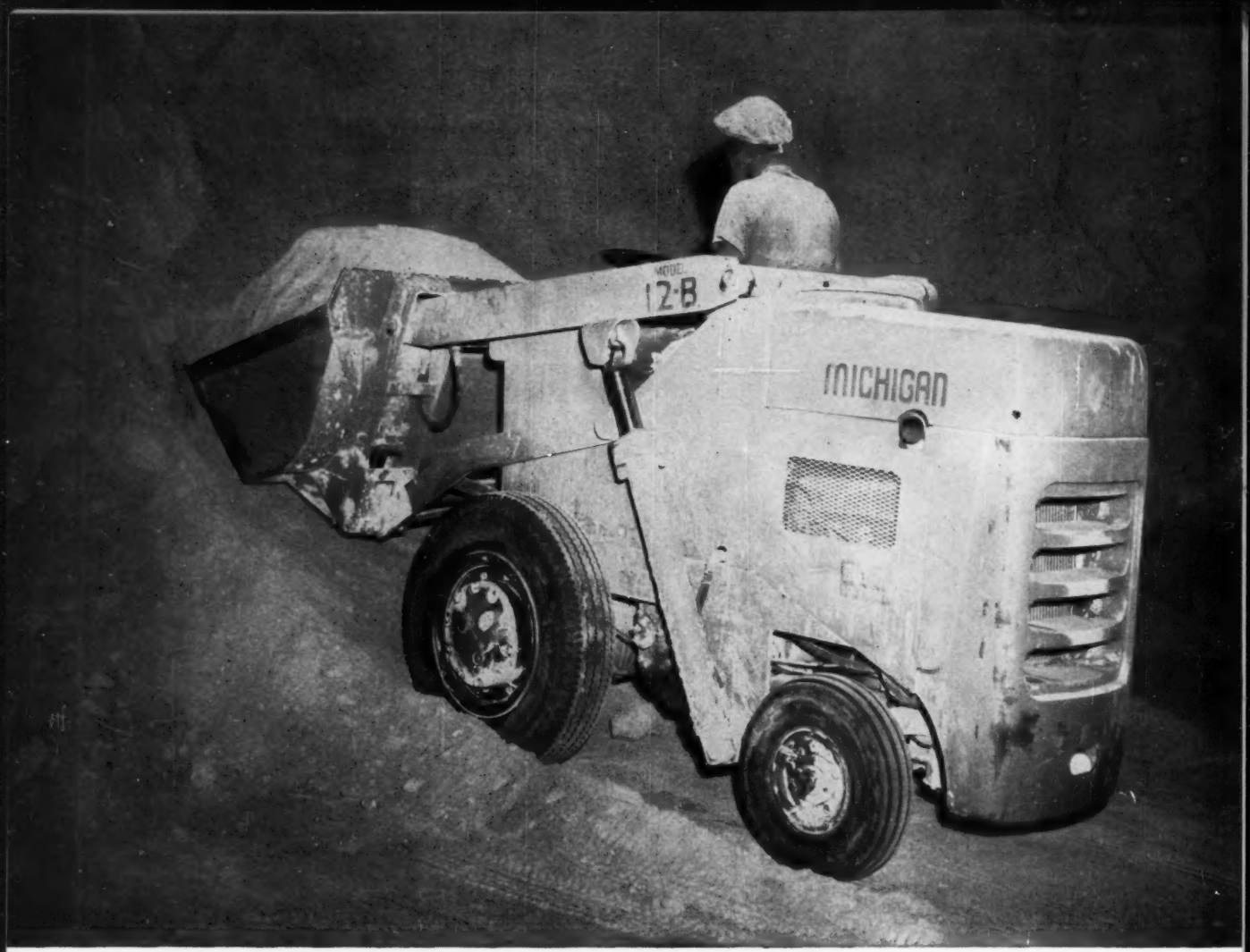
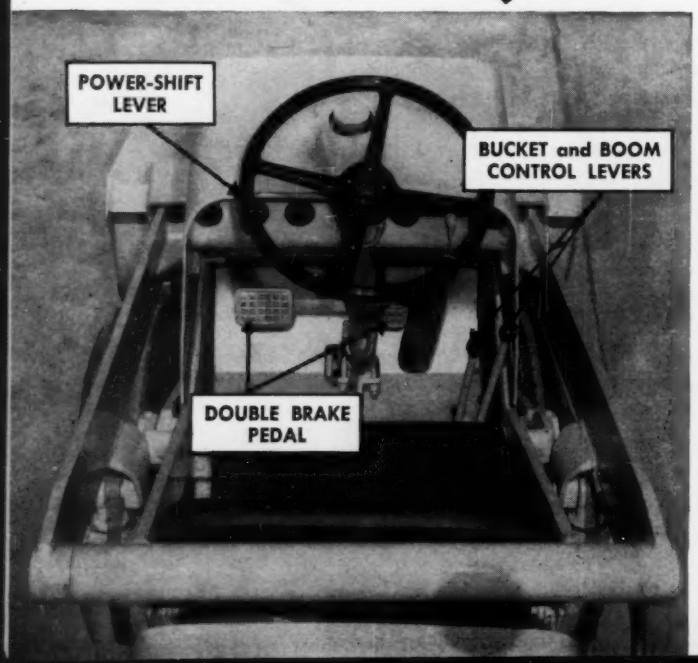
District Office: 11 South Portage Path, Akron 3, Ohio.

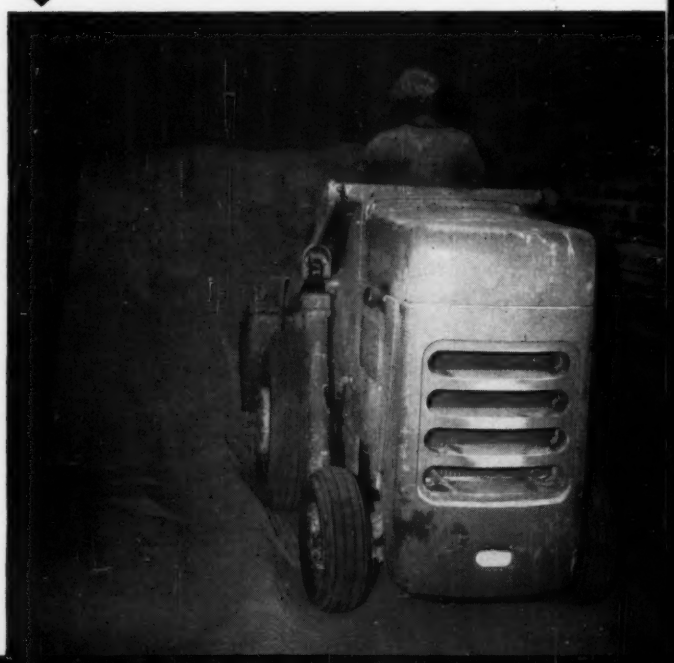
35 SUCCESSFUL YEARS OF LEADERSHIP IN SERVING INDUSTRY



It's a pleasure to work here! There's plenty of leg room in the 12B because there are fewer operating controls . . . no clutch pedal, no conventional gear-shift levers. The power-shift lever on the steering column controls the shifts: High—11.2 mph; Low—5.6 mph; Reverse—10.5 mph.



LOOK, NO CLUTCH. Without taking his left hand from the steering wheel, the operator can move the power-shift lever to any speed or direction . . . even when moving. The right hand is free for the bucket controls; feet are free for brake and accelerator. The 12B is more maneuverable in tight quarters because the operator doesn't have to stop to shift.



Report on the 15 cu. ft. MICHIGAN 12B:

New Tractor Shovel features power-shifting, twenty per cent more weight and power

Heavier and more powerful than comparable machines, and infinitely easier to operate—that's the new MICHIGAN 12B. There's no clutch pedal or engine clutch on the 12B: Clark's power-shift transmission completely eliminates this notorious cause of excessive maintenance and down time. From the cutting edge of the 15 cu. ft. bucket to the flywheel of the 44 or 42 horsepower engine (gas or diesel), the MICHIGAN 12B is simply *more* machine.

20% more weight and power. At 6250 lbs. (6350 lbs. diesel), the 12B is 20% heavier than most machines in its class. With 44 or 42 horsepower, gas or diesel, it is 20% more powerful. This margin of weight and power, plus bucket break-out action, enables the 12B to dig its way into material where other machines merely spin their wheels. The 12B's extra weight, low center of gravity and low-level bucket carry-position contribute to its superior stability: you can handle maximum loads safely and fast within its short turning radius.

Exclusive Clark power-train. The complete power-train of the new 12B is designed and manufactured by Clark. This combination of torque converter, power-shift transmission and planetary wheel axle gives you the most advanced industrial power-train on the market today. It was designed especially for industrial Tractor Shovel service—based on Clark's many years of experience as the leading manufacturer of industrial material handling equipment.

Instant power-shifting. Engine torque is multiplied up to 300% by the Clark torque converter—automatic torque build-up as you meet tighter, tougher materials. To shift between High, Low or Reverse, simply push the single power-shift lever to the desired position. Hydraulic power in the constant mesh power-shift transmission makes any shift instantly, even when travelling. There's no clutch pedal, no engine clutch, no gear clash. And as any operator will tell you, *it sure beats riding a heavy clutch all day!*

Complete dust protection. The 12B is protected against dust and dirt in every conceivable way. An oil bath air cleaner filters the air which enters the main hydraulic reservoir. There is a filter for the torque converter oil and the power-shift transmission oil. A partial flow filter protects the engine lube oil. Transmission, torque converter, starting motor and generator are all dust-sealed. On the 12B, every precaution has been taken to avoid dust problems.

Make your own comparison. Neither words nor specifications can indicate the working superiority of the new MICHIGAN 12B. You've got to see it in action—see it handling your toughest job. Call your local MICHIGAN distributor or write us direct to arrange an on-the-job demonstration. The new 12B is available on a low cost, no-down-payment Lease Plan—ask for details. Whether you lease or buy the 12B, it will pay for itself faster than any Tractor Shovel you've ever seen. See it!

MICHIGAN is a trade-mark of Clark Equipment Co.

CLARK EQUIPMENT

CLARK EQUIPMENT COMPANY
Construction Machinery Division
432 Second Street
Benton Harbor 36, Michigan

Rugged bucket mechanism. The 12B's bucket mechanism is designed for strength and simplicity. There are no bell cranks; the boom and guide bar are straight members with fewer wearing parts. At 4 inches off the ground, you get 38 degrees tip-back. Positive "stops" on the bucket carrier provide clean dumping action.

Personnelwise:

How to Spot a Lemon

First step in directing the work of others involves sizing up their abilities. Know what to look for and you'll save time and accomplish more.

SAMUEL STORCHHEIM

Because people differ so markedly in their abilities, the job of getting things done through them can be an extremely complicated proposition. But for the engineer who moves into a post of management responsibility, it's also a challenging opportunity. The success or failure of his career hinges on how he meets this challenge.

First problem to face him—and it's one he'll be up against throughout his career—involves rating the men in his charge. When he solves this he'll know how to make the best use of his time in directing their efforts.

Observing Comes First

But before he can rate them, the engineer must learn to observe. Not the laboratory type of observing tangible results and measuring physical quantities, but rather an awareness of the intangibles such as ability and character. Accurate appraisals of this type result from experience and constant practice in carefully and continuously watching and listening for each man's reactions to various on-the-job situations.

As he gains such experience, the engineer-manager learns where his close attention yields the greatest dividends.

All Need Supervising

Obviously, some of his men will consistantly outperform the others in any series of job assignments. Though all require some degree of supervision—since even the most competent do not necessarily accomplish every task assigned them—the less competent have a greater claim on the boss's time.

It's part of his job to help them, to develop them, and this means he must keep closer tabs on them. It's also sound business sense to identify these less competent workers as early as possible. As they grow more competent their need for supervision drops drastically—allowing the superior to extend himself further and effectively increasing the size of his work force.

Spot 'em Early, Save Time Later

It's important that the boss be able to identify these men early to prevent future errors and to keep minor matters from reaching crisis proportions.

In one firm, an engineer with marginal ability and an erratic performance record came up for a promotion after several years of service. He made a good impression when the chief engineer interviewed him and lacked only his project leader's recommendation before getting the nod.

This put the project leader on the spot. He could recall a number of instances in which the fellow in question had made serious blunders. Yet, these had gone virtually uncorrected and unrecorded, and the man had always been given regular raises at appropriate intervals.

To oppose promotion now would put the project leader in an embarrassing position. But so would "going along" when it was evident that the job would be far too big for the man. If the promotion is denied, the engineer must be given an explanation—so far he's had every reason to believe that he's been doing well. Granting him a boost he isn't qualified for only opens the door to more trouble.

At the crisis stage, the situation requires much time and attention. But no matter what the decision now, little good can come of it. The project leader's time would have been far more profitably invested had he kept a periodic rating of his men with a written record of their successes and failures, and devoted the bulk of his time to developing less competent ones.

In One or Two Groups

What should you look for to spot such "lemons" while there's still time to work with them and improve them?

A Harvard study some months back revealed that inability to do the work was the reason behind less than 35% of industrial dismissals. On the other hand, an ap-

Warning Signals

Resented by coworkers.
Dislikes coworkers.
Holds doggedly to preconceived notions.
Resists changes.
Neglects details.
Lacks basic knowledge.
Lacks emotional security.
Falls behind in work.

SAM STORCHHEIM *speaks from experience in directing projects in metallurgical development. A New Yorker, and a graduate of Brooklyn Polytech, he has long been interested in the problems engineers face as they move into management.*

Originated by General American in 1944

today, more than 4000 GATX flued-dome tank cars are leased to industry

Back in 1944, General American's research department completed development of a way to make tank cars easier to line, add structural strength, simplify cleaning, and minimize corrosion. This revolutionary development . . . the *flued-dome* tank car . . . was immediately accepted by railroads and shippers.

Now, eleven years later, U. S. railroads haul GATX *flued-dome* cars everywhere carrying products ranging from ammonium nitrate to hydrogen peroxide . . . from glucose to latex . . . from muriatic to sulfuric acid. The GATX *flued-dome* car was another of the many innovations pioneered by General American . . . leader in tank car design.

Another rail shipping success!

The aluminum tank car is typical of the more than 4000 *flued-dome* cars in the GATX fleet. There are over 200 different types in the fleet . . . designed, built and operated by General American—all leased to industry without capital investment.

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parent inability to get along with fellow workers was far and away the main factor in the bulk of the cases investigated.

First consideration then in rating those in your charge should be the way they mesh with the rest of your crew. Not that every man should be cast from the same mold, but be wary of those who stir resentment and strong dislikes in their coworkers. You'll soon find fellow-workers doing everything to delay and disrupt them and, naturally, over-all efficiency and morale suffers.

Caught in the early stages, a few words to those involved will snuff the flames. Put off action and a flood of corrective measures—ranging from physically separating the antagonists to dismissal—will be needed.

Keep Those Notions in Mind

Strongly held preconceived notions should also flag your attention. It isn't uncommon to suddenly find that the holder has validated them—by the simple process of rationalizing what may be completely contradictory information.

Such perverted stubbornness appears to be more common among older men, but wherever it appears it's a danger. One way to deal with it is to have the man go through his reasoning process with you step-by-step. You'll then be in a position to help him see his error and to point to the results of his action.

Take This Cue and Act

Whenever one of your men draws a wrong conclusion from a set of facts, it's your cue to find out why. Here are the trouble-spots to check:

- Lack of basic knowledge, proper training or innate ability.
- Undue haste caused by job pressure or by a desire to make a favorable impression.
- Deliberate falsification.

Unfortunately, when a lack of knowledge of basic principles is the cause, the obvious solution—taking the needed courses or instructions—isn't always practical. The superior can, however, require the man to do a sufficient amount of the proper reading and assign him as understudy to a more experienced worker.

Lack of proper training or ability may indicate a failure at your end. There are few positions for which a new man doesn't need some sort of training. And training is part of your job.

The poor fellow who just doesn't have what it takes presents a different problem. Put him in the proper slot and you'll turn him into a producer. You, he and the company will benefit. Usually, it's best to simply bring him to the personnel department's notice.

In many cases, false conclusions result from haste. And, while a desire to make an impression on the boss may sometimes be the underlying reason, it can also be caused by the superior's pressure for results.

Reason for Dismissal

In addition, certain workers will deliberately falsify or withhold information needed by others. This dishonesty is doubly hard to spot if you allow yourself to become remote from your men. It usually stems from such factors as fear of revealing an error, desire to show accomplishment or jealousy toward the receiver of the information.

Lurking behind the first two is a strong need for approval. Once this situation is recognized, minor cases can be handled rather easily. Generally, all it takes is a good calling down. Major transgressions call for disciplinary action. A jealous refusal to cooperate with others forms a strong basis for dismissal.

Finding the Fakers

Just as dangerous, in my opinion, are those who blow a smattering of information up into what appears to be a mountain of knowledge. Weak point with these fellows is their lack of attention to details, and they can generally be tripped up in little things. Further, they'll usually fail in any period of stress.

It's been my experience that such fakers are invariably found out within a year. Easing them out of the organization often proves to be the only practical solution.

Then too, there are those who are just plain lazy and who do not like to work. They'll strive harder to dream up an excuse or alibi than they would think of doing to get a job done.

Paradoxically, an intelligent, but lazy fellow can turn out to be one of your most valuable workers—if you can supply the motivation to get him working. Out of kindness to himself, such a fellow will invariably find the easiest and simplest way to do a difficult job—a way that others, too, can use to advantage.

You'll have to keep constantly on his tail and you may even have to

Reactions on Registration

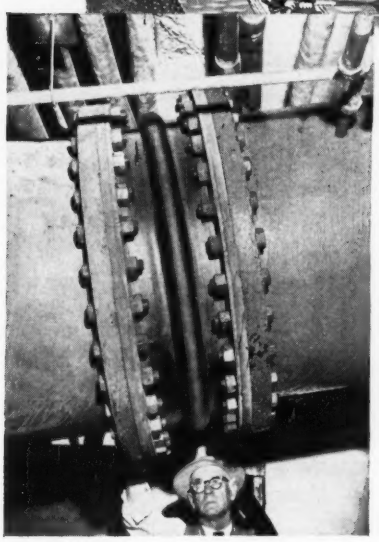
In August's You and Your Job, John D. Constance discussed the various state requirements for professional registration of engineers.

We're indebted to Mr. C. H. Evans, Chairman of Delaware's state board of registration for the following information: ". . . this article lists the various state boards . . . the listing for Delaware is erroneous. Present secretary is Mr. Frank T. Lynch and the board office is located at 11 E. 12th Street, Wilmington, Del. We are happy to see an article of this type in a chemical publication."

From Dayton, O., William L. R. Rice, 1/Lt., USAF, writes: "The article by Constance was quite excellent as far as it went. But I would have been most interested to have his views on another point, mutual recognition of various states for engineers registered in other states. In the future article that is apparently planned, I think that a short discussion of this point would be most valuable."

Mr. Constance tells us that an article covering this point is "in the works" and you'll be seeing it soon.

KEEPING A CITY'S FEET DRY...



Note great size of this U. S. Expansion Joint installed on a generator in the New Orleans S&WB plant at Eagle and Spruce Streets

for over 26 years U. S. Rubber Expansion Joints have been doing just that!

New Orleans is a city nestled in a saucer. Surrounded on all sides by water, many of its areas are below sea level. Add to this, one of the heaviest rainfalls in the country (as much as 15 inches in 17 hours) and you can see that this glamour city could easily be flooded.

But the New Orleans S&WB* keeps the city's feet dry by means of a pumping system that carries off the rain. Turbo-generators supply the power not only to operate this drainage pumping system but also the separate sewage pumping and the water supply systems.

26 years ago, one of these turbo-generators *(in use 98% of the time)* was equipped with 5 United States Rubber Company Expansion Joints. Why? To allow for contraction and expansion in pipe lines, and to counteract vibration. Says the Chief engineer of the S&WB: *"The U. S. Joints have never failed in all that time.* If any of them ever had, the turbine would be out of use."

U. S. Expansion Joints are widely used in the pipe lines of utility generating plants, municipal water supply systems, office and apartment buildings, ships – wherever pipe lines have to be protected against vibration, contraction and expansion. These joints soon pay for themselves by eliminating expensive maintenance and replacement in pipe lines. They eliminate noise. Once installed, you can count on years of trouble-free service. Obtainable at any of the 27 "U. S." District Sales Offices, or write address below.

*Sewerage and Water Board

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"U. S." Research perfects it..."U. S." Production builds it...U. S. Industry depends on it.

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MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

throw a scare into him, but you can often come up with a very valuable man.

Countless Variations

The types outlined here are representative of those to be found at the lower-rated end in the average group of workers—be it a team of researchers, a squad of draftsmen, a crew of pipefitters or what-have-you. You'll find countless variations of these basic types throughout the chemical industry. The suggested method of dealing with each type is that which the writer's experience has shown effective. In different circumstances, different tactics may be called for.

But the ability to spot less competent personnel while there's still time to help them is a trait of good management. The boss who's good at it can set up reasonable work programs—programs which get the best work from his men and which allow him to make the best use of his own time.

How Professional Engineers' Earnings Compare *

Branch	Low 10%	Low 25%	Median	High 25%	High 10%
Chemical	6,140	7,510	9,730	13,680	21,600
Civil	5,360	6,360	7,880	10,730	17,450
Electrical	5,570	6,730	8,560	11,520	16,390
Mechanical	5,750	6,910	8,780	12,300	18,630
Mining and Metallurgical	6,170	7,250	8,980	12,550	17,850
Other	5,700	6,920	8,990	12,760	19,920

* In 1954
Source: National Society of Professional Engineers.

SALARIES RISING

. . . *For Professionals*

On the average, the professional engineer makes 7.8% more money than he did in 1952.

This finding comes from the latest income and salary survey run by the National Society of Professional Engineers. Chemical engineers who have their professional licenses earn a median salary of $9,730 per year, well above the median for all engineers, $8,460. The survey included engineers in all types of practice—government, industry, education and private. Executive-administrative work and design were the jobs held by the bulk of the respondents. A third of the 14,328 replies came from men engaged in the former, while a quarter of the total came from design engineers.

Executives surveyed earn a median salary close to $11,000, a 9.7% increase over their 1952 earnings. Median for sales engineers is about $9,300, 11.1% higher than in '52, while for research and development men the boost was 7.7%, to $8,000. Design and production men both median at around $7,500, up 3.9% and 5.3% respectively.

. . . *And Others, Too*

Another survey, covering engineers and other professional employees in industry, has just been completed by the American Management Association. AMA covered 20 engineering and professional job categories in 19 industries. A majority of the companies surveyed granted a salary hike to men in this group last year. These boosts average 4.5% of 1954's salary.

AMA was surprised to find that despite reports that professional people are in short supply the salaries reported fell in a narrow range. The survey found that the average beginning engineer receives about $4,500 a year. Median annual pay for industrial engineers runs about $6,000, for chemical positions it's $6,000 and $7,000 for electrical and mechanical engineers.

These pay levels, which AMA says are about the same as those of production foremen, seem to vary little with either geographic location or company size.

TO THINK BETTER

. . . *Try Helium*

A "heliumized" office that would make you a more efficient thinker is the newest idea advanced by the inventor of the famous Momsen lung, Rear Admiral (Ret.) Charles B. Momsen.

The admiral thinks it would be practical to pipe a helium-oxygen mixture—the same combination which enables deep sea divers to work more efficiently and with less fatigue—into offices, schools, hospital operating rooms, etc., where a high level of mental activity is expected.

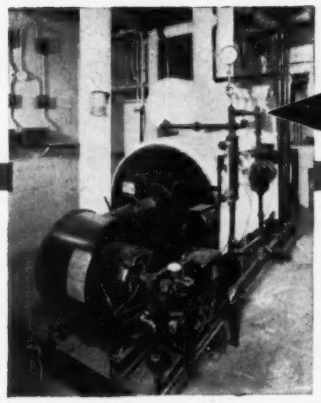
Momsen claims that in the $He\text{-}O_2$ atmosphere, you could work 12 hours a day without fatigue, and the increased efficiency of your brain would enable you to do six hours work in four. Transition from a heliumized office to normal atmosphere might make you feel as though you've had a drink or two. "But, after all," says the admiral, "almost everybody stops for a drink or two on the way home anyway."

The sailor-inventor's earlier development, the Momsen lung, circulates exhaled air through a purifying agent, permitting it to be inhaled again.

NEXT MONTH:

ENGINEER SHORTAGE

To help you evaluate for yourself the mass of numbers, facts and opinions on the supply-demand picture for technical men, we've asked a front-rank expert to discuss this much-abused subject. Watch for his clear-headed comments in November's You & Your Job.



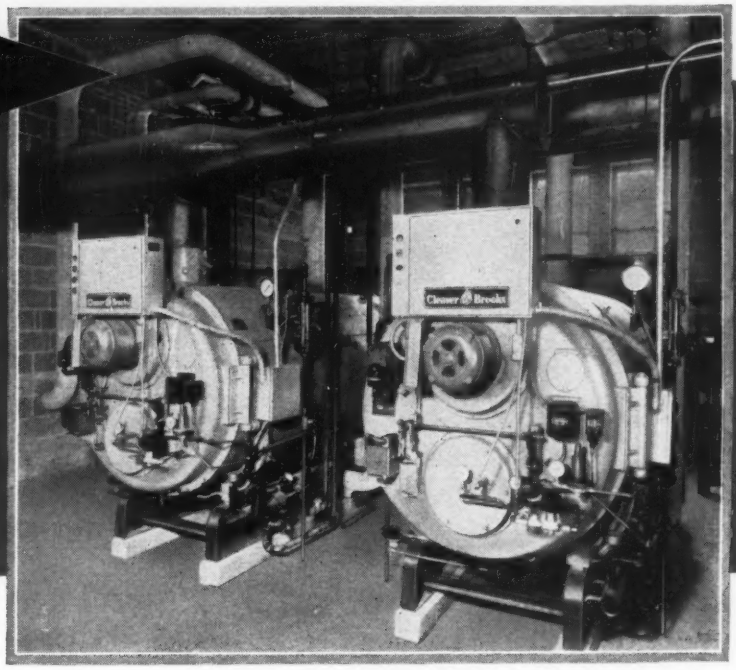
1931

Cleaver-Brooks pioneers big steam capacity in small space

This veteran 20-hp heating boiler — built by Cleaver-Brooks and installed in 1931 — is still in daily use. It is proof of the dependable service you can expect from Cleaver-Brooks' famed four-pass, self-contained boiler construction for any heating or processing need.

1955

Cleaver-Brooks is first again with the ALL NEW "CB" boiler



The "CB" is the most easily maintained package boiler on the market. Removal of only nine bolts (on the largest sizes) opens hinged doors for fast inspection, cleaning or service. This convenience has earned widespread praise of insurance firms.

- **All main burner components are completely integrated for automatic operation.**
- **More boiler capacity in less space through elimination of extended burner assembly platform.**
- **Guaranteed 80% efficiency — Four pass construction. 5 sq. ft. of heating surface per bhp.**
- **11 sizes — 79 models — 15 to 150 hp, (steam or hot water) for oil, gas or combination oil/gas use. Other models available through 600 hp.**
- **Complete (Boiler-Burner) unit approval by Underwriters Laboratories — conforms to ASME codes. Factory tested before shipment.**

BOILER users will quickly appreciate the surprisingly silent operation of the new forced-draft "CB" — *with the fan mounted inside the front hinged door.* Design avoids use of thin sheet metal housings and usual "chattering" and vibration.

Even greater combustion efficiency is yours with the new "CB" air-atomizing burner, with integral air compressor. All burner components are confined to the front head and the control panel is at operator eye level.

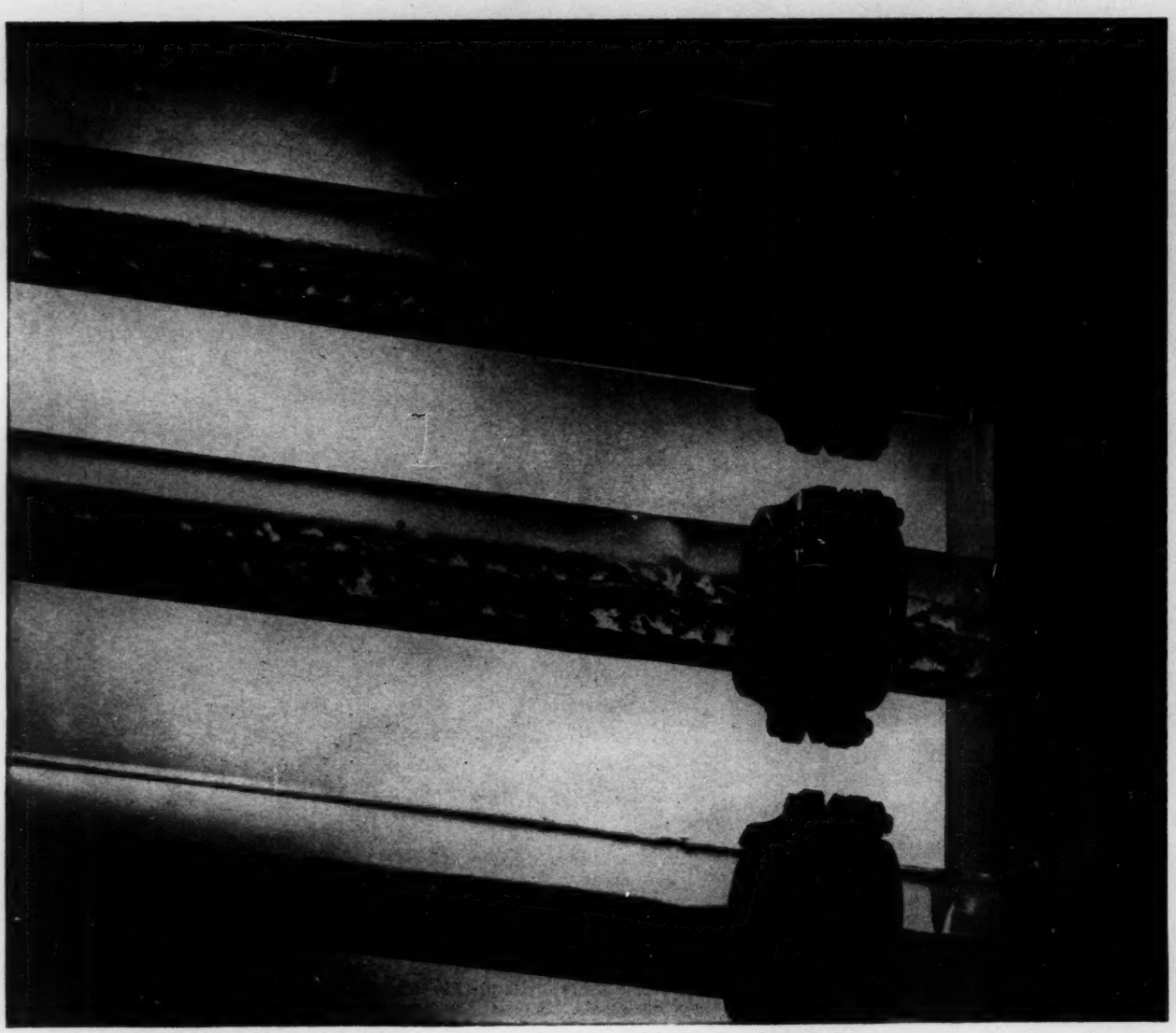
For complete facts on the boiler that's ahead in design, performance and economy, write: Cleaver-Brooks Company, Dept. L, 345 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CLEBRO — Milwaukee — All Codes.

Write for copy of latest "CB" Boiler Bulletin covering your size requirements — contains specification data to help you plan.

Cleaver Brooks

Originators of the self-contained boiler

Are you missing the



You'll find that PYREX pipe does a superior job with such acids as sulphuric, hydrochloric, nitric, and acetic; and with such materials as chlorinated hydrocarbons, hydrogen peroxide, bromine, brines, and low-concentration alkaline solutions.

MORE INFORMATION FOR YOU

Space doesn't permit us to describe in detail all the advantages of using PYREX pipe—its clear transparency (you're almost certain to find this a great convenience); how you can plumb it in your own plant to meet any layout requirements; its relatively light weight; comparative costs. So let us send you any or all of the bulletins listed in the coupon on the opposite page.

You need only fill out the coupon and mail it to us for prompt action. Or, if you prefer to discuss your own specific problem immediately with one of our representatives, write, wire, or phone us, or our nearest distributor.

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corrosion resistance of PYREX® pipe because you think it will break?

LOOK what one plant manager says. "There was no breakage during installation. There have been no lines broken because of the product handled, the temperatures involved, or the age of the pipe. There has been no accidental breakage. In short—there has been *no breakage.*"

Every "product" line in this plant has been PYREX pipe since 1943. The company switched to PYREX pipe because metal lines were quickly corroded by the acids in the products handled. Corrosion in the metal piping also made cleaning difficult, and the frequent replacements made maintenance very costly.

Thousands of engineers and operating men in hundreds of plants across the country have had the same experience with millions of feet of PYREX brand glass piping. If you are not enjoying the trouble-free corrosion resistance of PYREX pipe, because you are worried about breakage, why not talk to some of the people who are using it daily. We will be delighted to furnish you with the names of companies near you.

You can install it easily

More than 75% of the PYREX pipe now in use has been installed by our customers' own pipefitters. Proper installation is a relatively simple matter; you can plumb it in your own plant to meet any layout requirements. It is easier to hang than many other kinds of corrosion resistant pipe, as there are no special hard-to-catch-on-to tricks about it. Our installation manual covering every detail is yours for the asking. And remember, once your PYREX pipe is in place, you can count on it for a lifetime of service.

Why PYREX pipe today is more durable than ever

The greatest strain on any type of pipeline is usually set up at the joints due to misalignment or lack of flexibility. To offset any such strain, all PYREX pipe ends and fittings (except U-bends) are now tempered, which makes them up to four times stronger than previous fittings. In fact, we know of instances where the metal bolts have been accidentally tightened to their breaking point without the glass yielding. Alignment of lines is also easier now because of improved gasketing materials, inserts and a complete line of spacers and adjustable joints.

Maintenance problems can be reduced

The liquid smooth surface of PYREX pipe does not pit. Deposits do not build up, so your product lines keep up to planned volume. Cleaning is simple, when necessary, as you can see the interior of the pipe at all times. Most users find their pipeline maintenance problems are reduced to a periodic inspection of joints and occasional tightening of flange bolts. One plant superintendent said, "Since PYREX pipe was installed for all of our product lines, maintenance has been practically nil."

RECOMMENDED WORKING PRESSURES—TEMPERATURES

Pipe Size	Maximum Recommended Working Pressure	Maximum Sudden Temperature Differential	Maximum Operating Temperature
1"	50 p.s.i.	200° F.	450° F.
1½"	50 p.s.i.	200° F.	450° F.
2"	50 p.s.i.	200° F.	450° F.
3"	50 p.s.i.	200° F.	450° F.
4"	35 p.s.i.	175° F.	450° F.
6"	20 p.s.i.	160° F.	450° F.

What does it cost?

Initial cost of PYREX pipe compares favorably with most other corrosion resistant piping . . . and it is less expensive than some. Subtracting low installation cost, economical maintenance and long-time service from initial cost puts PYREX pipe on the profit side of your plant budget instead of the cost-of-operating side.

STANDARD SIZES PYREX BRAND GLASS PIPE

I.D., Inch	O.D., Inch	Mean Wall Thick., Inch	Stock Lengths (Feet)	Approx. Weights Lbs./Ft.
1"	1 5/16	5/32	½ to 10	0.6
1½"	1 27/32	11/64	½ to 10	1.0
2"	2 11/32	11/64	½ to 10	1.3
3"	3 13/32	13/64	½ to 10	2.0
4"	4½	17/64	½ to 10	3.4
6"	6 5/16	21/64	½ to 10	6.3

CORNING GLASS WORKS, CORNING, N. Y.

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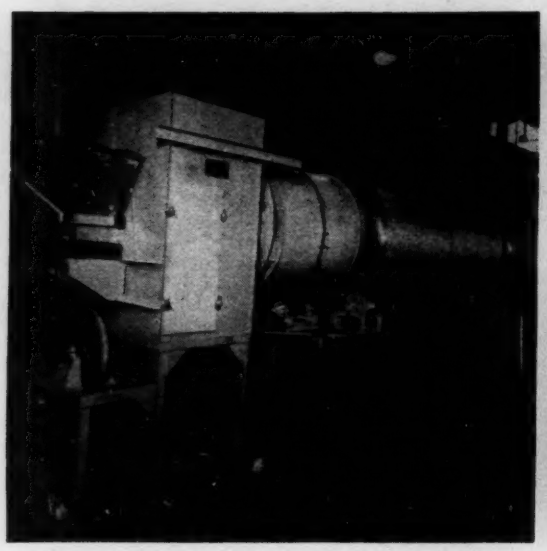
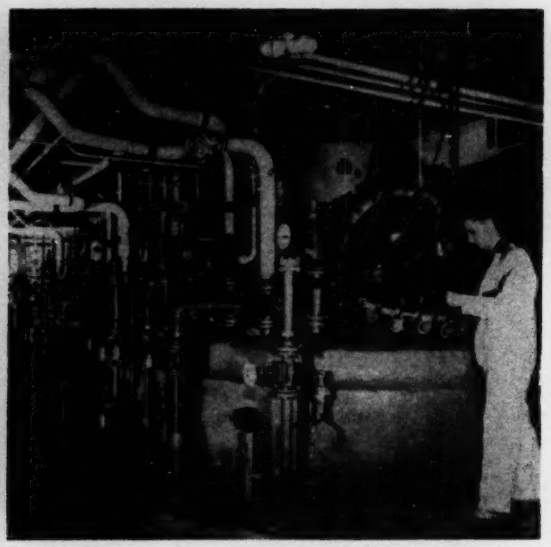


NICKEL-CLAD dryer runs K_2CO_3 without metal pickup.



INCONEL-CLAD tanks. Inconel pipe for chloromycetin.

What You Should Know About Clad Steels

Whenever your equipment contacts some substance that plain steel will not resist chemically or mechanically, clad steels may be the most economical choice.

Henry F. Peters, Lukens Steel Co.

A clad plate is a composite plate made up of two or more different metals permanently and integrally bonded over their entire interface. Clad steels consist of a cladding of either nickel, stainless steel, Inconel, Monel or copper, completely bonded to either a carbon or low-alloy steel backing plate.

They were developed to provide at low cost the well-known corrosion resistance, abrasion resistance and other benefits of these costly metals—making their advantages economically practical for large vessels, tanks, agitators, towers, heat exchangers, etc.

Pioneered in 1930 as a joint effort between Lukens Steel Co. and The International Nickel Co., the first nickel-clad steel plate was produced for the construction of a railroad tank car to transport iron-free caustic soda. After a quarter-century's service, carrying first caustic soda and more recently phenol, this tank has required no maintenance other than exterior painting. It is as good as new today, and continues to protect its cargo against contamination.

As a result of the success of this first use, other applications were thoroughly explored. Early in the program, nickel-clad steel was adopted for evaporators producing high-purity caustic soda. Then in 1934, Inconel-clad steel was manufactured for use in the food, beverage and pharmaceutical industries. Later, Monel-clad steel was developed primarily to meet certain needs of the salt industry and for increased resistance to sulfuric acid. It is also widely used in pharmaceutical manufacture and in the oil industry. In 1947, stainless-clad steels were introduced, available in most standard stainless specifications. More recently, still other clads—such as copper—have been developed.

HENRY F. PETERS *is manager of the market development division, Lukens Steel Co., Coatesville, Pa.*

Clad Steels Are Economical

While clad steels have found their widest application in the construction of tanks and pressure vessels for many industrial processes, they are also widely used for such equipment as mixers, bulk handling equipment, rolls and dryers—wherever metal is in contact with some substance that plain steel would not resist chemically or mechanically. Properly selected cladding material will:

1. Prevent or reduce corrosion, abrasion or oxidation.

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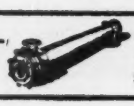
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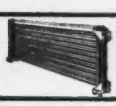
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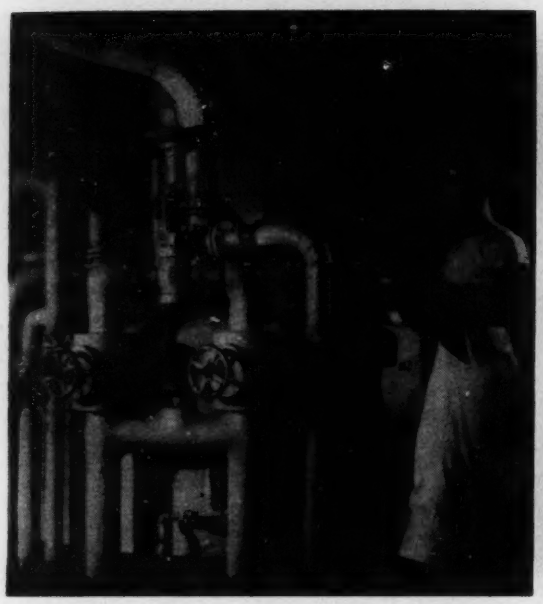


STAINLESS-CLAD fermenter guards antibiotic purity.

NICKEL-CLAD still speeds up glycerin distillation.

2. Prevent contamination of the substance in contact with the metal as, for example, food or chemical substances that are being processed.

3. Supply desired properties such as high strength, good electrical conductivity, or properties suitable for bearing applications.

Clad steels possess the same corrosion or abrasion-resistance as the solid cladding metal, yet cost substantially less than the solid material.

Properties and Characteristics

The two dissimilar metals bonded together into a clad steel plate cannot be separated in the normal course of fabrication and service life. When subjected to hot forming, gas cutting, shearing, hot and cold bending, they perform as though they were a solid metal—without buckling, cracking or peeling of the layers.

The bond in clad steel plates is a weld formed over the entire interface by pressure and high temperature, generally produced by rolling on a plate mill. Sealing of the pack and use of electrolytic nickel plating on Monel, high-chromium alloys and copper assures a metal-to-metal contact and complete bonding of the steel to the cladding. The thin, but continuous, high-nickel layer at the bond of the finished clad plate retards carbon diffusion from the backing steel during subsequent heating operations.

Clad steel plates are regularly produced up to 3 in. thick. They are available, by special arrangement, in heavier gages. Tensile strength of the clad plate with the exception of copper-clad is equal to, or better than, the tensile strength of the carbon steel backing plate. The ASTM specification for clad steels requires a 20,000 psi. shear strength at the bond line, but actually the values are far in excess of this specification.

The backing plate is generally carbon steel, but may be any low-alloy steel of flange or firebox quality conforming to ASTM, ASME, AAR or other standard plate specifications.

Because of the wide range of selection of backing material, advantage can be taken of the high-tensile strength of carbon-silicon or low-alloy steels, or the elevated or sub-zero temperature properties of molybdenum or nickel steels.

Corrosion and abrasion-resistant properties of the metals used as cladding are unchanged by being bonded to steel.

Boiler Code Vessels

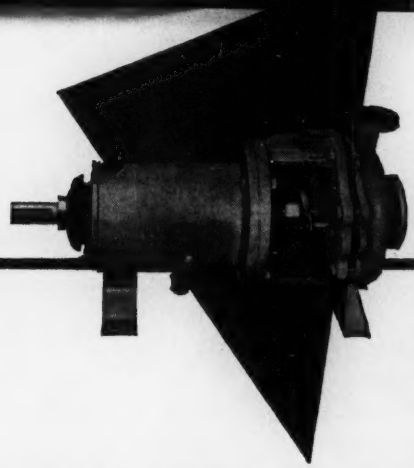
The use of clad steels conforming to specifications SA-263, 264 and 265 in code vessel construction is covered in section VIII, part UCL of the revised edition of the ASME code for unfired pressure vessels. Prior to the approval and publication of part UCL, clad steels were taken up in case 896 published in *Mechanical Engineering*, Dec., 1948.

Total thickness of stainless and

NEXT MONTH:

BEST LEAD DESIGNS

To capitalize fully on the corrosion resistance of lead in chemical plant applications, it is essential to pay close attention to mechanical design details. The engineering division of the Consolidated Mining and Smelting Co., Trail, B.C., has just prepared an extensive report on this subject, giving the benefit of their long experience with the use of lead. For the highlights, see next month's Corrosion Forum.



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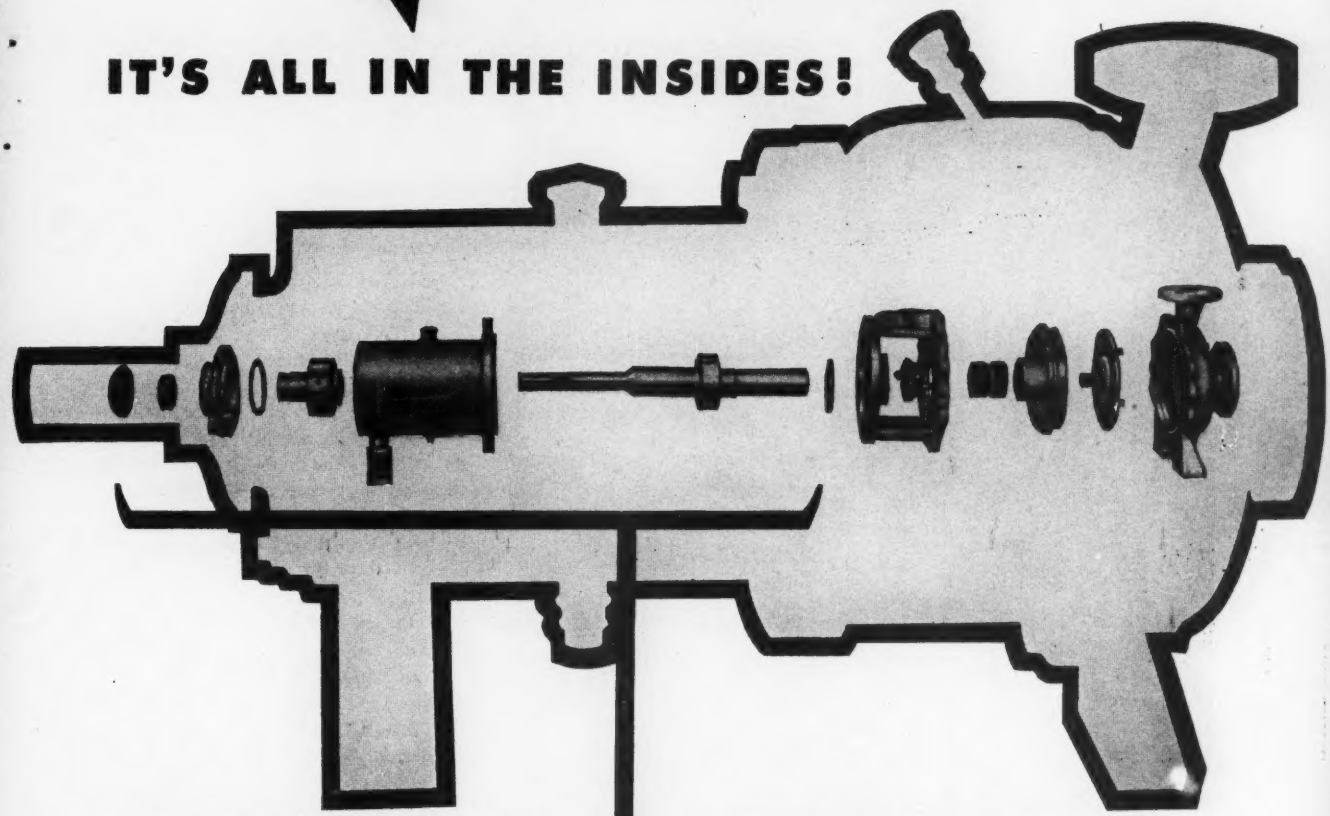

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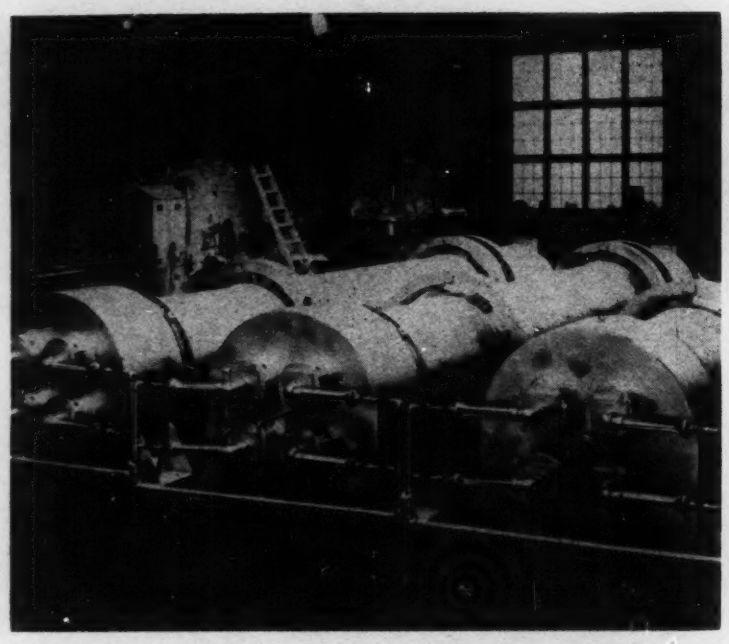
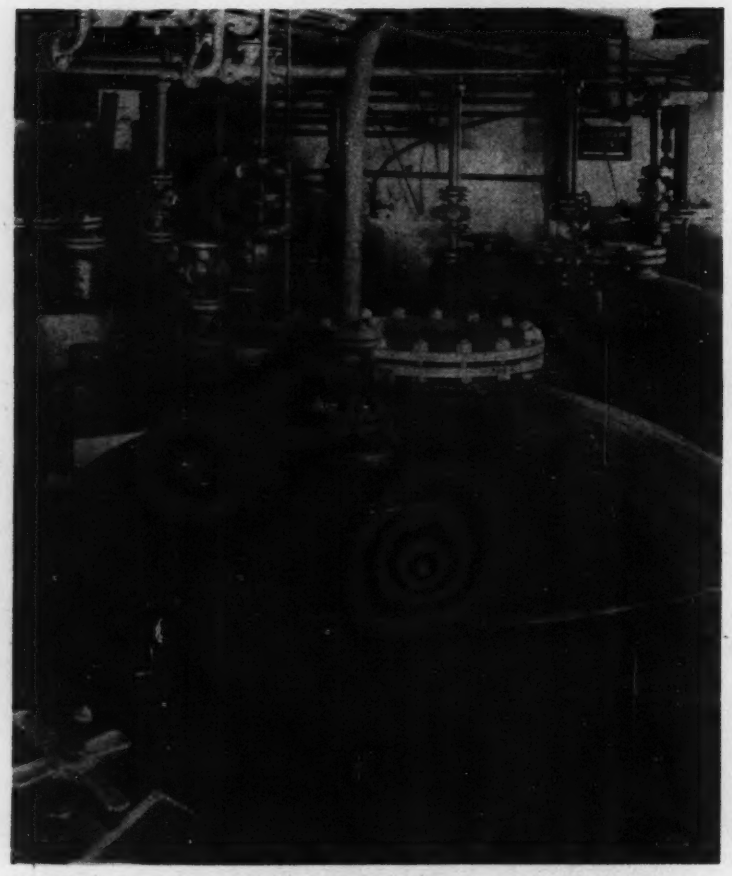


DRYERS with nickel-cladding and solid nickel baffles make pure dry salt.



WEIGH tanks in plastics plant have nickel cladding to avoid corrosion.

nickel alloy-clad steels complying with specifications SA-263, 264 and 265 is permitted by the code to be used in design calculations. In the case of copper-clad, however, only the thickness of the backing steel may be used.

Necessity for stress relieving and x-raying welded clad steel joints according to the code is governed by the backing steel specification and the total thickness of the clad steel. For further details relating to clad steel code vessels and welders' qualification tests, part UCL, section VIII of the ASME unfired pressure vessel code should be consulted.

Forms and Sizes

Cladding thickness is usually specified as a percentage of the total thickness of the composite plate. Most common thicknesses are 10% and 20%, but thickness from 5% to 50% can be obtained by special arrangements. Also, under certain circumstances, the cladding thickness may be ordered in fractions or decimals of an inch, such as 7/64, 0.050, and the like, regardless of the composite plate gage.

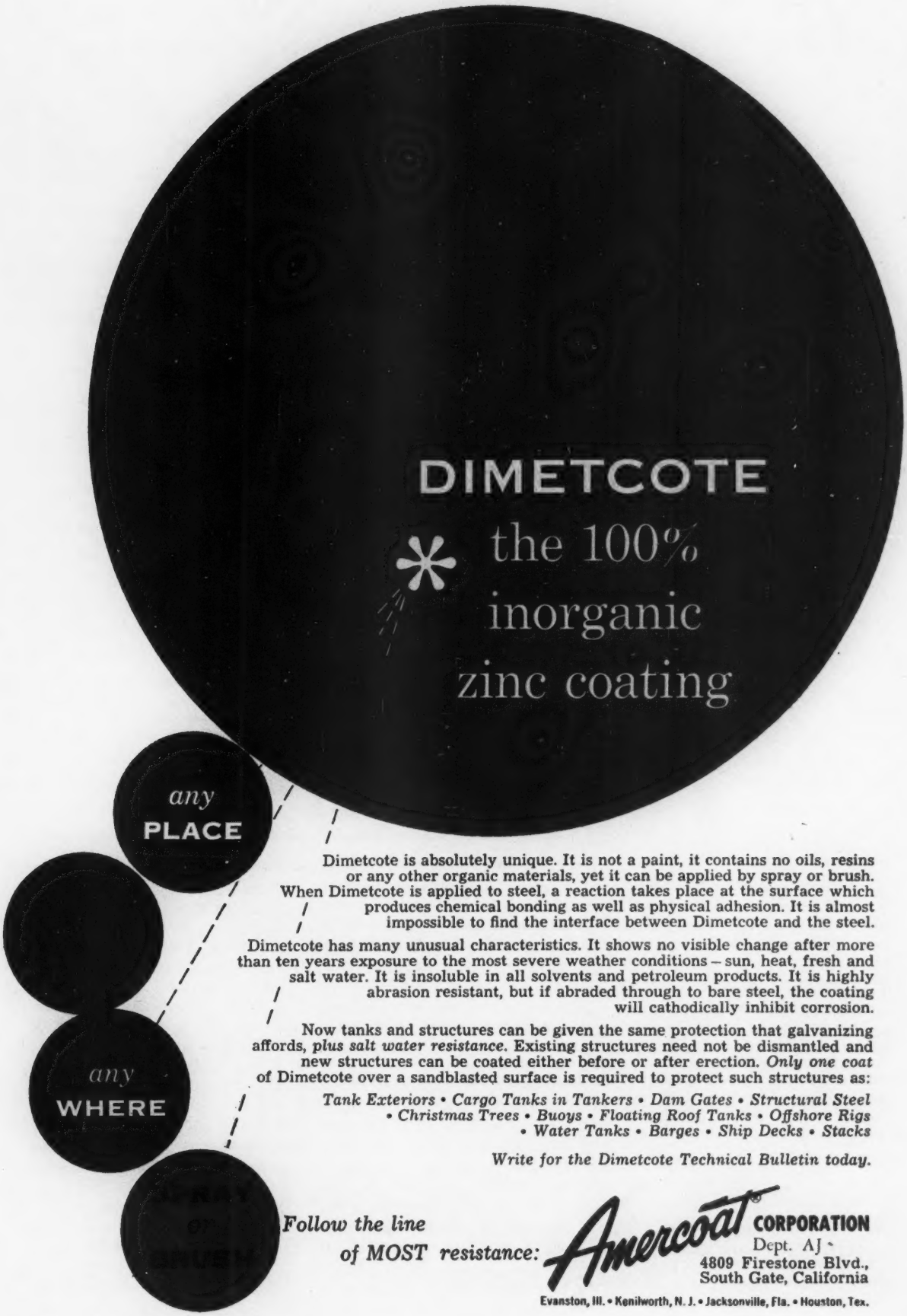
Both sides of the backing plate may be clad with corrosion-resistant material for uses such as partitions in vessels. When certain unusual corrosive conditions are found, double-clad plate consisting of nickel on one surface and Inconel on the other surface of the carbon steel backing plate, for example, can be produced.

Clad steel plates can be furnished up to 178 in. wide, 480 in. long, and up to 6 in. thick. Plates over 456 in. long cannot be sodium hydride descaled (the normal procedure), and must be blast cleaned.

Clad steel heads are also available in many stock shapes, and in sizes ranging from 4 in. to over 20 ft. 8 in. diameter. Clad steel heads are regularly produced up to 2 in. in thickness, but heavier gages (to over 3½ in.) are available by special arrangement.

Thermal Conductivity

Vessels made of clad steels have an appreciable advantage over many



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Dimetcote has many unusual characteristics. It shows no visible change after more than ten years exposure to the most severe weather conditions – sun, heat, fresh and salt water. It is insoluble in all solvents and petroleum products. It is highly abrasion resistant, but if abraded through to bare steel, the coating will cathodically inhibit corrosion.

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solid high-alloy or lined vessels. Where external heat is applied, the good heat transfer properties of clad steel assure faster heat-up and cooling, and more uniform heating than lined plates or plates of solid high-alloys. Exception is nickel-clad which has the same thermal conductivity as solid nickel. This faster heat transfer is a result of the better heat conductivity inherent in the carbon steel or low-alloy backing plate and the continuous metal-to-metal bond of cladding to backing.

Fabricating Clad Steels

Clad steel fabrication presents no difficult problems. Integrity of the cladding material must of course be maintained in such operations as welding. Material should be handled with the same care that plates or sheets of the solid high alloy material normally receive to avoid surface damage and contamination. For example, clad steel plates should be handled around the shop with the clad side up to prevent gouging and deep scratching. Bending rolls, dies and tools should be wiped or brushed clean of loose scale and steel particles that otherwise might be inbedded in the clad surface.

Care must be taken in pickling, grinding, polishing, removal of welding flux and any similar operation to avoid penetration of the cladding.

Imbedded foreign matter, gouges and deep scratches not only reduce the cladding thickness but also may act as focal points for corrosion.

To avoid contamination with shop dirt, a protective paper coating may be pasted over, or a plastic coating may be sprayed on the clad surface. When an edge is to be welded a strip of this paper or plastic, from 1 to 3 in. wide (depending on the plate gage), must be removed. If attachments are to be welded on the reverse side, this coating should be removed from the clad surface in the vicinity to prevent burning.

▶**Heat Treating**—Controlled heat-treating procedures are desirable in stress-relieving corrosion-resistant high-alloy materials. Conventional equipment is used, but control of time and temperature is important. The material should not be exposed to a direct flame if gas or oil is used as fuel. Carbonaceous substances such as marking paint and protective oil should be removed from the clad side before heating. Wherever possible, the plates should be heated with the clad side up.

Maximum Hot Working and Annealing Temperatures, °F.

Popular Name	ASTM Spec.	ASTM Grade	AISI Types	Maximum Hot Working Temp.[1]	Annealing Temperature Range and Rate of Cooling
12% Cr	A263	O	405	2100[2]	1250-1300[3 or 4]
12% Cr	263	A	410	2000[2]	1425-1475[3]
17% Cr	263	D	430	2000[2]	1425-1475[3]
18-8	264	3	304	2100	1800-2000[4]
18-8 Extra Low Carbon			304 L	2100	1800-2000[4]
25-12	264	8	309	2100	2050-2150[4]
25-20	264	10	310	2100	2050-2150[4]
18-8 Mo	264	11	316	2100	1900-2150[4]
			316 Cb	2100	1900-2150[4]
18-8 Mo Extra Low Carbon			316 L	2100	1900-2150[4]
			317	2100	1900-2150[4]
18-8 Ti	264	5	321	2100	1800-2000[4,5]
18-8 Cb	264	6	347	2100	1800-2000[4,5]
Nickel	265	Nickel[6]		2300	1500-1600[4]
Monel	265	Nickel-Copper alloy		2150	1600-1700[4]
Inconel	265	Nickel-Chromium alloy		2300	1750-1850[4]
Copper	B152	OF, DHP		1650	700-1200

1 Do not heat above maximum temperature of hot working range.
2 Work to below 1,500 F. for maximum grain refinement.
3 Furnace-cool at 50 deg. F. per hour to 1,000 F., then air cool.
4 Air quench.
5 Can be annealed at 1,500-1,650 F. for 2 hr. per inch of thickness.
6 Low-carbon nickel should be used for applications involving long-time service in the range from 700 F. to 1,200 F.

▶**Shearing, Punching and Forming**—Shearing and punching should be done with the clad side up to throw the burr on the steel side. If sheared clad steel plates are to be welded, allowance must be made for shear droop (the break in flatness that occurs on the sheared edge due to shearing pressure). An allowance of ¼ in. diameter should be made in headers for this shear droop. This effect can be disregarded in light gage plates, or where the work is subject to further machining operations.

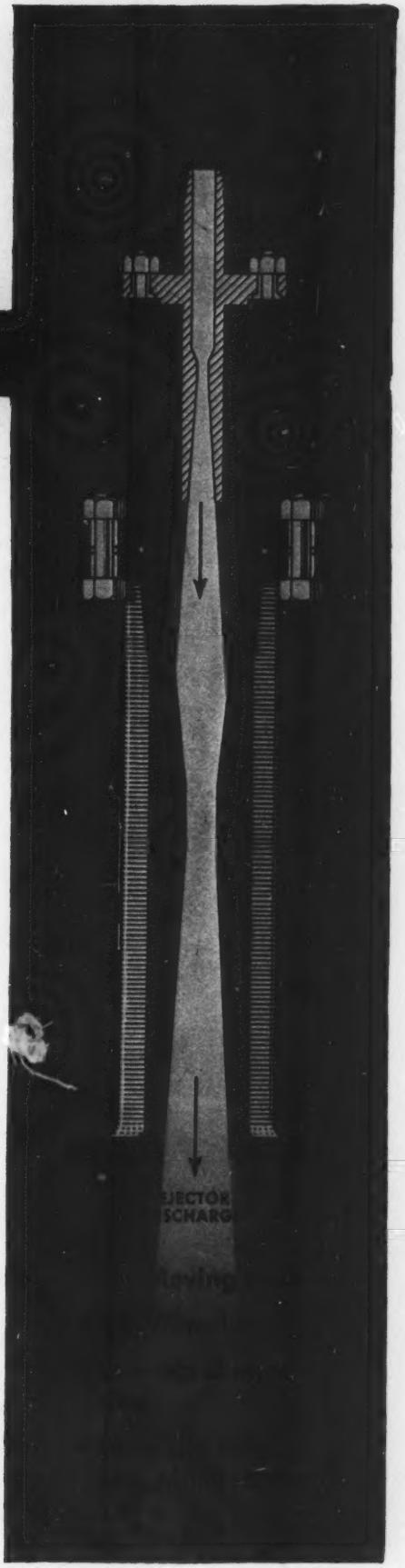
Material should be in the annealed condition when severe bending or other forming is performed. Compensation should be made for spring-back, and radii should be as large as possible. The straight chromium-clad stainless steels are not as ductile as other clads, and allowance should be made for this factor in both design and fabrication. Stresses arising from severe cold working should be removed by annealing.

▶**Machining**—The backing plate will machine with speeds and feeds used for mild steel. With chromium-nickel stainless claddings, the tool should not be allowed to ride

for low-cost suction pressures

EVACUATE BY STEAM

with



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the clad surface, as the material will work-harden and gall. With all types of cladding, the speeds should be a little lower than those used for steel, but feeds should be firm.

▶ **Flame Cutting**–Clean and smooth cuts can be obtained in all clad materials. Procedures have been established by which all clads (with the exception of copper) up to 35% can be flame cut without use of flux injection. Plate thickness and percentage clad determine tip size, oxygen pressure and cutting speed.

Embrittlement of straight-chromium cladding and carbide precipitation in chromium-nickel cladding, found along the line of cut, should be considered. Extent of the heat-affected zone along the line of cut will depend on the speed of cutting and plate gage. Affected material should be removed by grinding or machining to improve ductility or to remove precipitated chromium carbides, if afterward the plate cannot be annealed.

Scarfing of the steel backing for welding can be done by gas beveling.

Flame cutting of steel is done by the successive oxidation of the white-hot metal and the removal of the oxide. This is blown out or flows away as slag. With clad steels, the cladding is removed by the actual melting of alloy, assisted by the fluxing action of the molten backing steel. Thus, clad steels are cut with the cladding side down, where flux injection is not used.

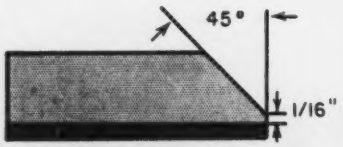
Best technique recommended for flame-cutting clad steels is the use of oxyacetylene, natural gas or propane, with low oxygen cutting pressure, cutting from the backing steel side.

Clad steels can also be cut from either side using the oxyacetylene cutting process combined with powder of flux injection, or special tubular electrodes with a controlled flow of oxygen through the center.

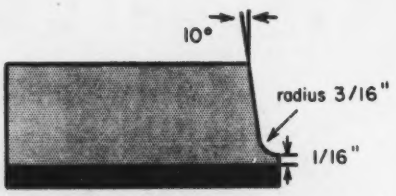
▶ **Arc Welding**–As the weld joining clad steel plates becomes a section of the corrosion-resistant material, it not only must supply structural strength, but must maintain the integrity of the clad surface. Clad steels are readily welded, but to insure success, proper joint design and welding procedure must be used. In general, the advisable procedure is to weld the steel side first and then the clad side.

Standard Welding Procedure for Clad Plates

Plate Preparation



For gages 3/16 in. to 5/8 in.

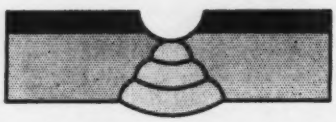


For gages 5/8 in. and up.

Welding Steps

1 Plate fit-up. Steel weld protected from high alloy pickup.

2 Steel side welded. Steel weld does not penetrate cladding.



3 Clad side prepared for welding by chipping or grinding.

4 Two passes applied to clad side to complete joint.

▶ **Finishing**–Many applications require that the weld surface be ground flush or that ripples be removed. The first grind is generally given with rubber or Bakelite-bonded aluminum oxide wheels of 16 to 36 grit. The wheel should be free-cutting and usually operates at 5,000 to 6,000 linear fpm.

Edges of the wheel should be rounded and grinding should proceed along the bead, care being taken not to tilt the wheel. A ⅛ in. 10% clad plate has only approximately 0.018 in. cladding, and a tilted wheel will soon cut through or seriously reduce the thickness of cladding. The wheel should be allowed to ride the work in the interest of efficiency, and should not be held too long in any one place because of danger of overheating the clad surface. Heat tinting will appear at approximately 400F.

Slag may also be removed from the weld area by hand tools, sand blasting or acid pickling.

▶ **Stress Relieving**–Vessels fabricated of clad steels may be stress relieved at usual temperatures and for the usual length of time, depending on the alloy cladding. A stabilized grade of stainless cladding should be used, however, to prevent carbide precipitation.

The heat treatment of fabricated vessels is usually a stress-relieving treatment, required in most cases by the ASME code. In the case of non-code vessels that are stress relieved to insure freedom from stress-corrosion cracking in certain media, the stress-relieving heat treatment is usually the same as that required for code vessels.

Further information regarding the welding and heat treatment of clad steel vessels and welded construction can be obtained from the manufacturers and marketers of clad steel materials.

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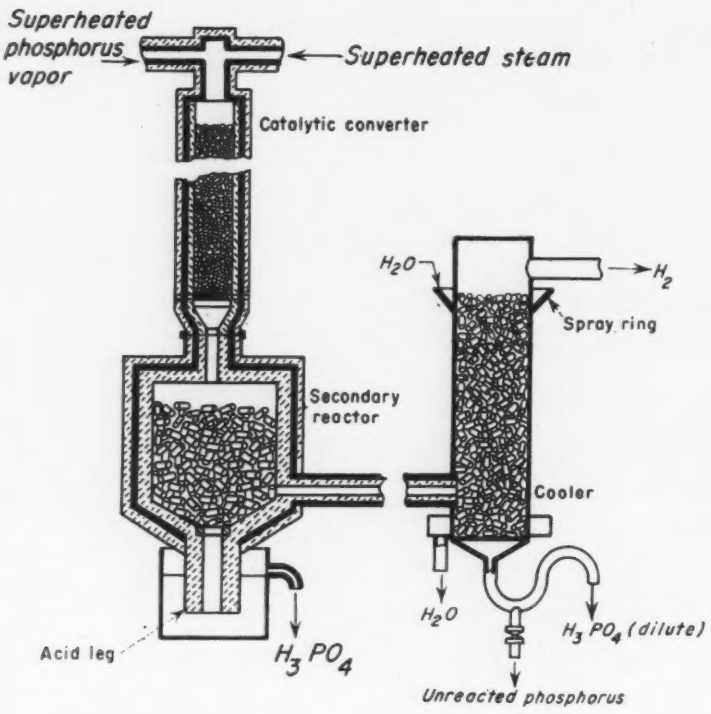
 Melvin Nord, Chemical Engineer & Patent Attorney, Detroit, Mich.



Improved H_3PO_4 Production

Modified vapor-phase oxidation of phosphorus with steam is simpler and cheaper than conventional oxidation processes, yields more concentrated acid.

What may prove to be the first commercially feasible process for vapor-phase oxidation of elemental phosphorus to phosphoric acid is the Tennessee Valley Authority's new 2-stage operation involving the oxidation of phosphorus with steam.

True, oxidation of phosphorus to the acid has been carried out before—via both liquid- and vapor-phase reactions. But, to date, neither technique has been successful. Why?

▶ **The Old**—Although the liquid-phase reaction has the advantage of low temperatures and generation of hydrogen under pressure, the reactants must be pumped (in emulsion form) into the reactor against high pressures. And this involves many operational difficulties.

Too, the amount of water required to give a stable emulsion results in production of a weak acid, too dilute for many purposes. Moreover, liquid-phase operation causes severe corrosion of equipment and converts part of the white phosphorus to the solid red form which causes plugging of equipment.

Conventional vapor-phase conversion involves other problems: Incomplete oxidation of elemental phosphorus and contamination of the product with phosphine and phosphorus acid.

▶ **The New**—TVA claims that its new process not only obviates these difficulties, but also provides a simple, economic means of producing a highly concentrated acid.

As shown, superheated steam and superheated phosphorus vapor feed into a primary catalytic converter containing a catalyst such as copper supported on zirconium pyrophosphate. Almost all the phosphorus is oxidized to the tri- and pentavalent states, but not all of it is converted to P_2O_5.

▶ **Secondary Reactor** — Reaction products flow from the converter into a secondary reactor which is packed with carbon Raschig rings and maintained at a temperature below the dew point of the gaseous mixture (usually 1,200-1,500 F.).

Here, phosphorous acid is converted to phosphoric and the latter is condensed. Concentrated phosphoric acid trickles down through the packing and leaves from the bottom of the reactor.

Uncondensed or uncollected gases and vapors—containing hydrogen, water vapor, entrained phosphoric acid and small amounts of phosphine—leave the secondary reactor and pass into a cooler. The latter is filled with packing and is cooled externally by a water film distributed over its surface by a spray ring.

▶ **Unreacted Vapors**—On cooling of the gas-vapor mixture, water condenses and mixes with the phosphoric acid to form dilute acid. This is withdrawn through a trap at the bottom of the cooler.

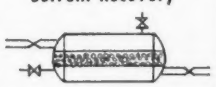
Any unreacted phosphorus which might be present in the vapors is condensed. And, being more dense than phosphoric acid, it collects at the low point of the trap from which it is removed from time to time.

Hydrogen containing small amounts of phosphine exits from the top of the cooler and, if desired, may be treated to remove the phosphine.—**U. S. 2,706,146 by Lawrence B. Hein, Donald W. Rindt, John F. Shultz and Grady Tarbutton to Tennessee Valley Authority.**

Here's how to solve your VAPOR PHASE ADSORPTION PROBLEMS with Pittsburgh Activated Carbon

TYPICAL BPL APPLICATIONS

Solvent Recovery



Provides proven performance and distinct cost savings in solvent recovery systems.

Gas Purification

Ideal for purification of many chemical and petrochemical gases. Example: Removal of sulfur impurities.

Catalysis

Excellent catalyst and catalyst support in production of vinyl monomers and similar applications.

Hydrocarbon Separation

Ideal for separating higher molecular weight hydrocarbons from gas streams.

Air Purification

Used in industrial air conditioning and purification of air required for aerobic fermentation.

Odor Removal

Used to reduce harmful and odoriferous components in waste gases to minimal concentrations.

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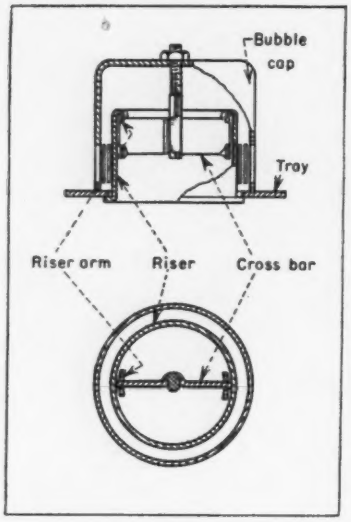


New Riser Construction Cuts Cost and Labor

Something new in bubble cap risers is this one which is held in place in the tray by the bubble cap.

As shown, the bubble cap rests on the tray. The riser is fashioned from a flat sheet of thin metal which has been extruded to cup shape. Both the top and bottom of the metal cup are removed, leaving a curved upper portion (riser top) and a flared bottom. After removing the bottom of the cup, a pair of projections remain.

▶ **Riser Arms** – These projections, the riser arms, are bent over on themselves to act as supports. A cross bar, supported in vertical slots in the riser arms, holds a vertical stud. The upper threaded part of the stud projects through an opening in the bubble cap. And a nut holds the riser in the plate opening.

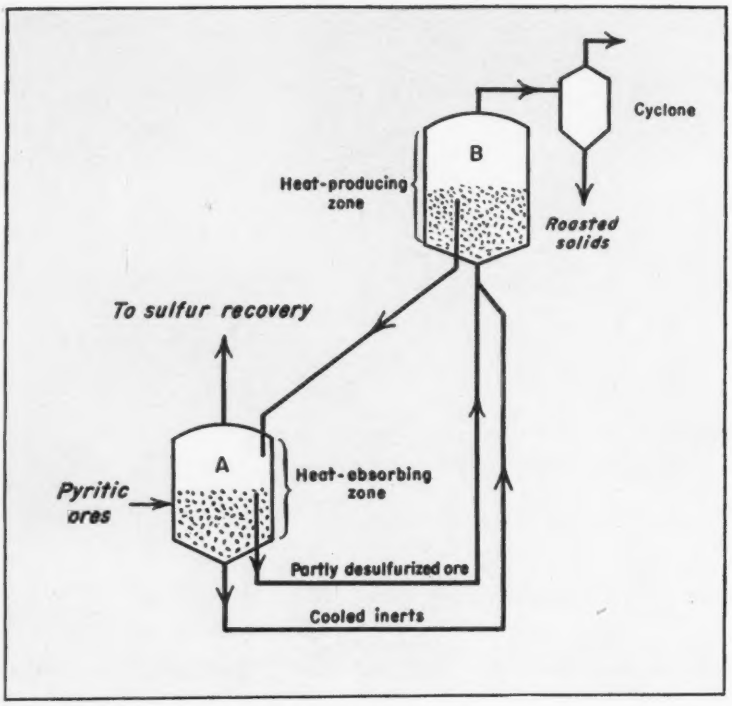
Since the riser arms are formed from metal which would otherwise be scrapped, savings in material and labor are effected.–**U. S. 2,705,136 by Hans C. Glitsch to Fritz W. Glitsch & Sons, Inc.**

Distillation of 3-Component Mixtures

Here's a novel method for controlling the operation of a distillation column in which the mixture being separated contains at least three different liquid components.

Successful control hinges on the volatility of the mixture's components, i.e., the volatility of one component must lie somewhere between that of the other two.

▶ **Regulating Variables** – The method of control is based on (1) automatically analyzing, in sequence, the concentration of the intermediate component at a number of points in the column and (2) using the analyzer's output to regulate one of the column variables–to maintain the concentration of the intermediate component within predetermined limits in either the top or bottom product stream.–**U. S. 2,709,678 by Donald E. Berger to Phillips Petroleum Co.**



More Efficient Endothermic Reactions

Heat transfer improved by fluidizing reactants. Technique applied to recovery of sulfur from pyritic ores.

In its new fluidizing technique for roasting pyritic ores (an endothermic reaction), the Dorr Co. attempts to overcome these conventional chemical and economic pitfalls:

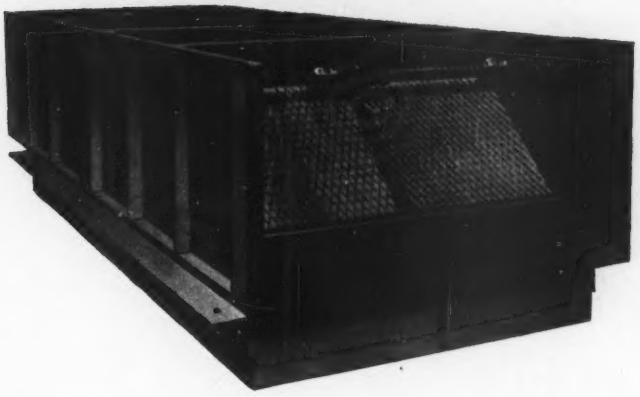
- Localized over- or underburning of particles.
- Non-recovery of excess sulfur.
- Poor yields.

In essence, the process involves (1) heating inert, heat-transferring pellets to a high temperature in a

This department is designed to keep you abreast of the latest developments in chemical equipment and processes. Any patents may be ordered from the Commissioner of Patents, Washington 25, D. C. The cost: 25 cents.

AIR CLEANING IN THE CHEMICAL INDUSTRIES

"Buffalo" Absorption Type Washer



NEW PROCESS PRESENTED AN ENTIRELY NEW CLEANING PROBLEM

solved by "Buffalo"

PROBLEM

A manufacturer recently developed a new product by firing various chemicals at extremely high temperatures. Tests of the gas effluent showed loadings of 2 to 4 grains per cubic foot and temperatures in excess of 400° F. Realizing that acid mists, vapors and fumes might constitute a health hazard and nuisance, the management ordered abatement measures as an integral part of the project activities.

SOLUTION

Since little was known about this new process, a small pilot air cleaning unit of only 600 cfm capacity was designed. Based on test results, a Design 7 "Buffalo" Absorption Type Washer with a preseparation stage, one wetted fibre stage and one dry fibre stage was selected. The first two stages remove particulates and absorb acid mists and vapors. The final stage eliminates free moisture.

RESULTS

The gas effluent is completely innocuous and well within health tolerance levels with 90% removal. Fume particulate concentrations were reduced to near invisibility. Tests of the pilot model had shown that 99% removal could be obtained, if desired, by addition of another filter stage.

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fluidized reactor, (2) feeding the heated pellets to a second reactor containing fluidized reactants, (3) cooling the inerts and recirculating them back to the first reactor, (4) recovering elemental sulfur.

▶ **Reactor A**—More specifically, this is how it's done. In reactor A, the following reaction occurs:

$$FeS_2 + \text{heat} \rightarrow FeS + S(g)$$

Finely ground pyritic ore is charged to the reactor and fluidized with gas (e.g. nitrogen or methane) having a velocity of about 1 ft. per sec. The size of the heated inert pellets is such that they are not fluidized with the low gas velocity in the reactor.

After settling out, the inert pellets form a non-fluid bed at the bottom of reactor A, then are withdrawn and fed—by a gas lift—to reactor *B*. FeS particles are allowed to overflow from the top of the fluidized bed in reactor A and are also fed to the second reactor. Sulfur vapors exit from the top of reactor A and are recovered.

▶ **Reactor B**—In reactor *B*, the FeS and inert pellets are fluidized with air at a relatively high velocity (6 to 10 ft. per sec.). And heat is liberated by the two following reactions:

$$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2 + \text{heat}$$

$$6FeO + O_2 \rightarrow 2Fe_3O_4 + \text{heat}$$

Enough heat is given off to raise the temperature of the pellets to that required for the endothermic reaction in reactor A. The velocity of gases in reactor *B* is high enough to not only fluidize the inerts, but also to carry fine Fe_3O_4 out of the chamber.

In addition to the above, the patent describes applications of the new process to the preparation of carbon disulfide from carbon and sulfur and the preparation of water gas from carbon and steam.—**U. S. 2,700,592 by Thomas D. Heath to Dorr Co.**

Solids Dried by Thermal Radiation

U-shaped radiating pipes supply the heat necessary to dry wet solids in this new vacuum dryer.

The pipes are located above a moving belt on which the solids travel through the drying chamber.

Pipe arrangement represents an improvement over a dryer design described by the inventor in an earlier patent application. —**U. S. 2,708,794 by Alfred Haltmeier to Farbenfabriken Bayer A. G.**

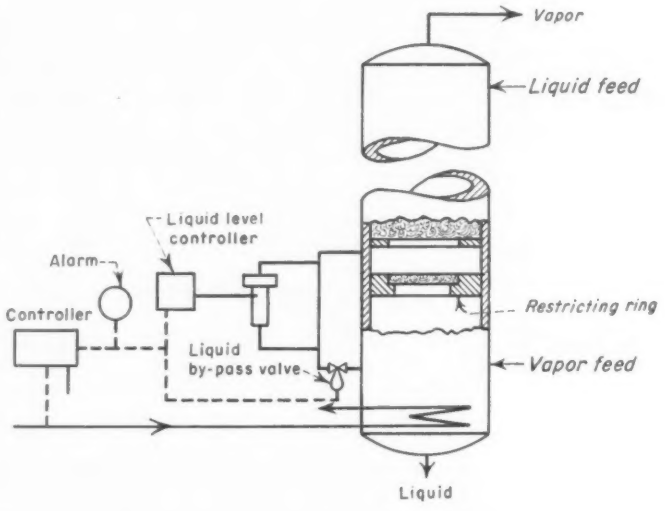
Waxes Decolorized With Less Adsorbent

Rapid decolorizing and deodorizing of waxes can be effected with less-than-usual amounts of solid adsorbent in this new 4-step process. The key: continuous passing of an inert gas through the wax-adsorbent mixture.

▶ **How It's Done**—Clay and molten wax feed into a mixing tank equipped with an agitator (step No. 1). The resulting mixture then passes to a heat exchanger where the temperature is adjusted to the desired value (step No. 2).

From the heat exchanger, the mixture goes to a soaking tank (step No. 3) into which flue gas is admitted—through the bottom. And finally, the mixture flows to a filter where clay is separated and decolorized, deodorized wax is recovered (step No. 4).

The continuous introduction of flue gas into the soaking tank is believed to cause continuous stripping of water from the clay, thus increasing its adsorbent power.—**U. S. 2,708,652 by William A. Ackerman to Sun Oil Co.**



Control System Checks Tower Flooding

How can you avoid flooding in a packed tower? This new control system may offer an answer.

Vapor flow is restricted at one point in the column so that flooding will occur here before it occurs anywhere else. In this way it's possible to determine incipient tower flooding before the tower actually floods.

At incipient flooding, a sort of chain reaction occurs. A liquid level appears above the restricting ring as well as in the liquid level controller. This sets off an alarm which, in turn, opens a liquid by-pass valve around the restriction.

When the valve opens, the steam supply to the reboiler is automatically reduced. Result: alleviation of flooding and resumption of normal tower operation.—**U. S. 2,705,699 by Dick D. Breese to Phillips Petroleum Co.**

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Fig. 2309—Flush Bottom Tank Valve for 150 Pounds W. P. Disc Opens Into Tank.

FIG. 2342—Flanged End Bolted Cap Swing Check Valve. For 150 Pounds W.P.

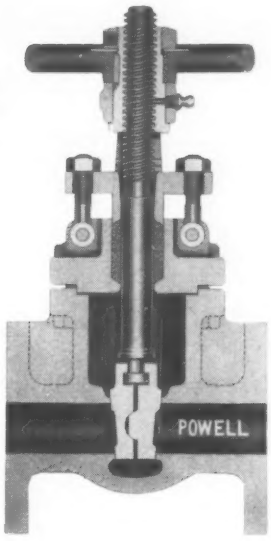

FIG. 2495 (Sectional)—Stainless Steel O. S. & Y. Gate Valve For 150 Pounds W. P. Double Wedge Disc Is Accurately Guided Into Seat.

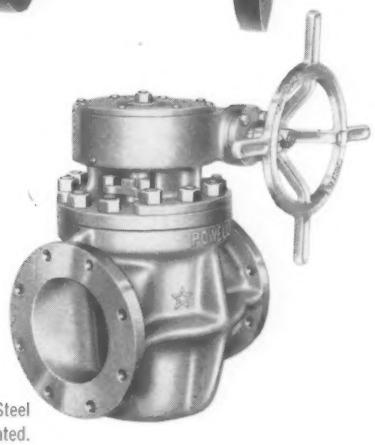

FIG. 3059-G—300-Pound Steel Lubricated Plug Valve. Gear Operated.

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Your Checklist of New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No. . .
Adsorption	Chromatographic adsorber	Commonwealth Engineering Co. of Ohio	2,708,519
Crushing and grinding	Screen changer for hammer mills	James G. Bryant	2,710,149
Distillation	Bubble cap assembly with choke	C. F. Braun & Co	2,710,177
Drying	Gas dryer	Socony Mobil Oil Co. Inc	2,709,496
	Drying adsorbent solids	Socony Mobil Oil Co. Inc	2,709,674
Extraction	Countercurrent extraction column	Universal Oil Products Co	2,709,641
Extrusion and molding	Apparatus for molding plastics	Frank W. Fuller et al	2,708,288
	Producing rigid tubes by continuously extruding hot thermoplastic material	British Celanese Ltd	2,708,772
Filtration	Device for cleaning a diatomite filter	Infilco Inc	2,710,099
Instrumentation and control	Device for continuously measuring density of unstable suspensions	Dept. of the Interior	2,708,360
Screening	Machines for screening and concentrating ores	Robert P. Fisher	2,709,521
Solid-gas contacting	Rotary apparatus for treating granular solids with a gas	AB Svenska Flaktfabriken	2,709,306
Solid-gas separation	Electrical precipitator combined with vortical separators	Research Corp	2,708,486-7
	Electrostatic precipitator	AB Svenska Flaktfabriken	2,708,488
	Electrical precipitator	Research Corp	2,709,497
	Liquid-bath air cleaner	Houdaille-Hershey Corp	2,709,498
	Centrifugal air separator for particle removal	William R. Carter	2,709,500
Solid-liquid contacting	Reciprocating liquid in solid-liquid contacter	Shell Development Co	2,709,643
Solid-liquid separation	Settling tank	James L. Dallas	2,708,520
Solid-solid separation	Solids classification	Esso Research & Engineering Co	2,708,516
	Ore separator	Theresa B. Lowe	2,709,003

. . . And New Process Patents

Product . . .	Process . . .	Inventor or Assignee . . .	Patent No. .
Catalysts	Activating CO conversion catalyst	Esso Research & Engineering Co	2,709,159
	Prolonging the activity of cuprous salt catalysts in the synthesis of acrylonitrile	Ciba Ltd	2,709,177
Dyes	Making cyanine dyes	Eastman Kodak Co	2,708,669
Fats and oils	Accelerated process for bodying vegetable drying oils	Esso Research & Engineering Co	2,709,662
Fuels	Production of a lignite fuel	Henry G. Lykken	2,708,654
	Finely divided coke from bituminous fuels	Koppers Co. Inc	2,709,152
	Oil gas production	United Engineers & Constructors Inc	2,709,646
Gases	Air separation	Air Reduction Co., Inc	2,708,831
	Air separation	Union Carbide and Carbon Corp	2,709,348
	Continuous production of dilute gaseous chlorine dioxide	Wallace & Tiernan Inc	2,710,246
Glass	Producing glass fibers	Soc. Anonyme des Manufactures des Glaces & Produits Chimiques de Saint-Gobain	2,708,813
Inorganic chemicals	Purification of ammonium beryllium fluoride solutions	U. S. Atomic Energy Commission	2,708,618
	Alkali phosphate production	Food Machinery & Chemical Corp	2,708,619
	Production of phosphoric acid	Food Machinery & Chemical Corp	2,708,620
	Recovery of elemental sulfur from gases	Phillips Petroleum Co	2,708,983
	HCN production	Deutsche Gold-und-Silber-Scheideanstalt-vormals Roessler	2,710,245
Organic chemicals	Manufacturing carbon disulfide in an electric furnace	Rumianca S.P.A	2,708,156
	Preparation of oil-soluble organic sulfonates	Shell Development Co	2,708,182
	Polysulfides preparation	Continental Oil Co	2,708,199
	Phenols production	Shell Development Co	2,708,208
	Process for selective crystallization of 2,5-dichlorophenol	Olin Mathieson Chemical Corp	2,708,209
	Purifying pyridine bases by distillation	American Cyanamid Co	2,708,653
	Production of highly concentrated gamma isomer of benzene hexachloride	Solvay & Cie	2,708,681
	Polymerizing olefins with slurried catalyst	Esso Research & Engineering Co	2,708,682
	Production of vitamin concentrates	Russel P. Dunmire	2,709,149
	Peptides production	C. H. Boehringer Sohn	2,709,164
	Olefins oxidation	California Research Corp	2,709,173
	Cycloalkanone oximes from reduction of cyclic nitroparaffins	De Directie van de Staatsmijnen in Limburg	2,709,179
	Production of chlorofluoroethylenes	B. F. Goodrich Co	2,709,181
	Carbon fluorides production	E. I. du Pont de Nemours & Co	2,709,182-92
	Dealkylation of aromatic hydrocarbons	Imperial Chemical Industries Ltd	2,709,193-4
	Converting thiophene to butadiene and butenes	E. I. du Pont de Nemours & Co	2,709,195
	Producing carbon disulfide	Food Machinery & Chemical Corp	2,709,639
	Vinyl sulfonamide preparation	Monsanto Chemical Co	2,709,707
	Manufacture of hydroxynaphthoic naphthalide	Imperial Chemical Industries Ltd	2,709,708
	p-hydroxybenzaldehyde recovery	Dow Chemical Co	2,709,710
Pigments	Amine-coated calcium carbonate pigments	Wyandotte Chemical Corp	2,709,160
Plastics	Preparation of plastics in cellular form	Ringwood Chemical Corp	2,708,661
Resins	Making abrasive phenolic resin mixes	Norton Co	2,708,622
Rubber	Manufacture of silicone rubber	Connecticut Hard Rubber Co	2,709,161
	Curing polyisobutylene	U. S. Rubber Co	2,710,291
Synthesis gas and products	Hydrocarbons synthesis using a hydrogen-sintered pyrites ash	Esso Research & Engineering Co	2,708,674
	Iron removal from aldehyde synthesis process	Esso Research & Engineering Co	2,709,713
Synthetic fibers	Ammonia recovery from cuprammonium rayon waste liquors	Asahi Chemical Industry Co., Ltd	2,707,670-1
	Making films and fibers from normally crystalline polymer latices	Dow Chemical Co	2,707,805
	Formation of films and filaments from polymer intermediates	E. I. du Pont de Nemours & Co	2,708,617

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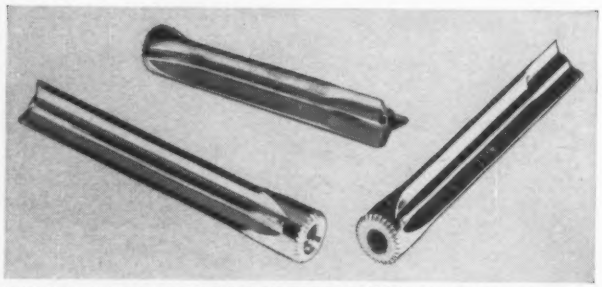

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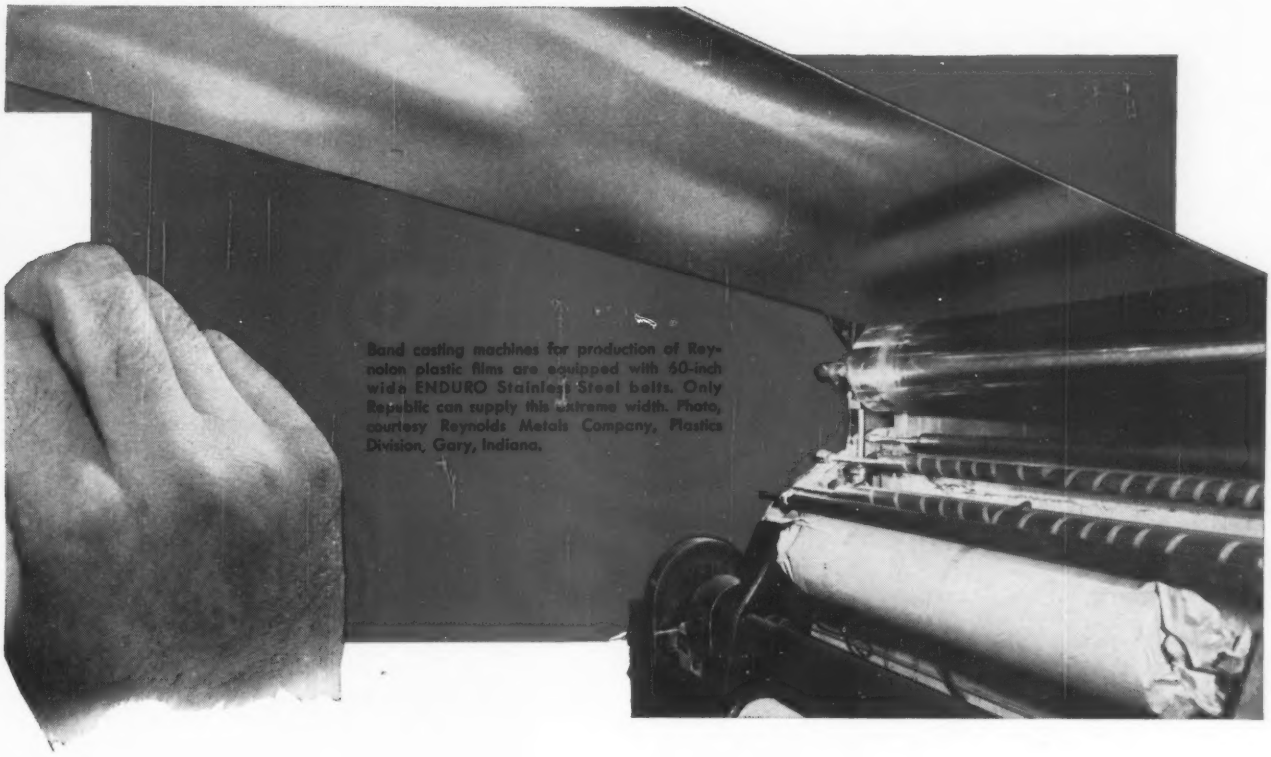

Band casting machines for production of Reynolon plastic films are equipped with 60-inch wide ENDURO Stainless Steel belts. Only Republic can supply this extreme width. Photo, courtesy Reynolds Metals Company, Plastics Division, Gary, Indiana.

This wide, polished ENDURO Stainless Steel belt carries Reynolon plastic coatings in process. One such type makes the peel-off backing for those handy packaged small bandages you use.

The ENDURO surface provides a high luster finish! Since the slightest scratch would be "mirrored" or duplicated in the finished product, the quality of the stainless steel surface determines the quality of the plastic coating. Here, ENDURO keeps scratches off bandages!

Note that the belt is supported only by top rollers. That allows both sides to carry the plastic material . . . speeds production. It also means that the belt must have great tensile strength. ENDURO supplies that strength. In this case, tension on the belt runs as high as 90 tons.

What's more, this belt must be heat-resistant. In process, material passes through 600° ovens. And, many of the plastics processed are in hydrous or acidic solutions. So, the belt must resist rust and corrosion. ENDURO does just that.

Four of these sixty-inch wide belts help produce Reynolon plastic film. Even at this extreme width, the belts must stay flat. "Crowned" metal could snap like an oil can and damage the plastic.

Republic metallurgists worked closely with Reynolds Metals Company, Plastics Division, to develop this unusual equipment. If you have process or product problems involving heat, corrosion, surface finish or strength, ENDURO Stainless Steel quite likely is your answer. Republic metallurgists will help you apply it most profitably. Write Republic.

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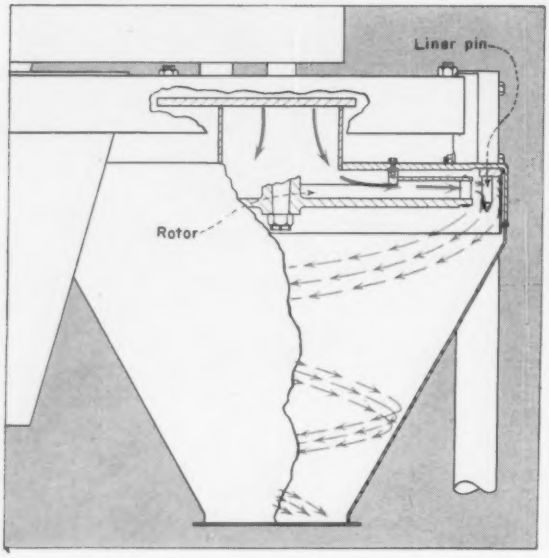

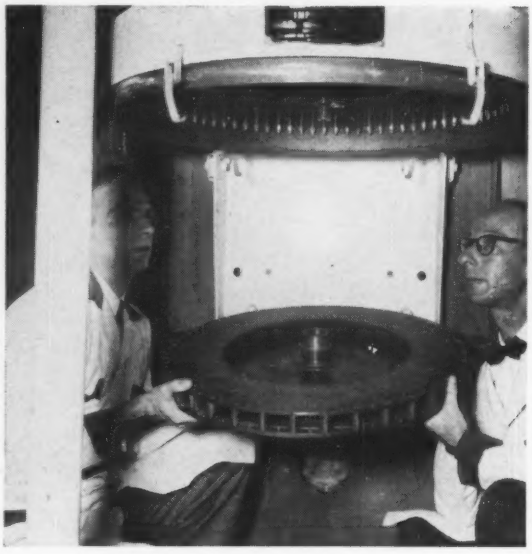

Mill Lined With Pins Gains Efficiency

Just revealed as basic design feature in high capacity mill. Makes for easy, low-cost maintenance; gives size reduction without creating excess fines.

With major wear problems licked by an extensive field testing program Entoleter Div., Safety Car Heating & Lighting Co. now is talking about its latest impact mixer and grinder, the 27-in. Big Inch. For the first time Entoleter engineers are discussing freely the guts of the machine; how they gulp and process solids and slurries economically at high tonnage throughput rates.

Ever since installing the first commercial 27-in. unit approximately two years ago Entoleter Div. has been pointing to what the machine can do without divulging the final details of how.

It's been known, for instance, that compared to any other impact mill this machine has double the output per horsepower. Also, that it can be run without producing any appreciable amount of fines, if such is desired.

▶ **New Liner**—Now, it appears that Entoleter has come up with a different type of impact surface against which the rapidly moving particles are hurled. Instead of having a continuous surface the machine is fitted with a liner of vertically mounted pins with free space between individual pins.

As the particles hurtle against this encircling barricade the fines stream through the spaces between the pins and are deflected downward without appreciable damage. Coarser particles collide full force against the pins, shatter or break apart and drop into the receiving hopper.

When the pin surface becomes worn a fresh surface can be presented merely by rotating the pin. Once it is worn all around it can be replaced with little effort.

With relatively long life for individual pins and easy replacement it is practical and economical to use the best materials available for the impactors. According to application needs these can be chosen from steel, stainless steel, Ampco 8 bronze, steel coated with Stoody Borod or a special ceramic formulation with outstanding resistance to abrasion.

▶ **How Machine Works**—For those not familiar with the Entoleter mill it is essentially a centrifugal machine. The rotor consists of two flat steel disks spaced 1⅛ in. apart. Around the periphery are pin-shaped impactors. The machine case is lined with pin impactors as noted previously.

Material fed into the center of the rotor is accelerated outward reaching top velocity as it impacts against the rotor impactors. Then slinging off the rim of the rotor it encounters the line of pins around the inside of the case.

how to avoid the high cost of

Repairs and Service Interruptions

Records over the past ten years show that LaBour PACKINGLESS Type G pumps in chemical service cost little or nothing—yes, nothing—for repairs. (There are Type G's running with all original parts after as much as seven years of service. A figure of a dollar or two per month per pump for repair parts is not uncommon.)

This means, of course, that time out for repairs is also at a minimum, as is the cost of labor for making the repairs.

So if pump service costs are running high in your plant, the logical answer to your problem is LaBour Type G. The new CG handles flooded suction as well as suction lift applications, so this economy is available in a wide range of services. Ask for Bulletin G-1.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. ★ Elkhart, Indiana, U.S.A.

Newsworthy Equipment This Month

Equipment Cost Indexes, p. 258

New Processing Equipment
- Pin Liner for Impact Mill 256A
- Vibrating Screen 258A
- Wire Filter Cloth 258B
- Aerator for Industrial Waste 260A
- Dryer-Blender 262A
- Horizontal Tank Filter 262B
- Small Evaporator 262C
- Liquid Cyclone 262D

New Packaging & Handling Equipment
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- Solids Flow Valve 264B
- Electric Vehicles 264C
- Screw Feeder 264D
- Molded Pallet 264E

New Electrical & Mechanical Equipment
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- Enclosed D.C. Motors 266B
- Flexible Conduit Connector 266C
- Variable Speed Pulley 266D
- Rerated TEFC Motors 266E
- Silicone-Protected Motors 266F

New Fluids Handling Equipment
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- Surface Pyrometer 270B
- Flame Control 270C
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New Materials of Construction
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- Steel Member 272B
- Roof Deck 272C
- Protective Coating 272D
- Construction Panel 272E
- Tank Lining 272F

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Size reduction by this machine is a function of mass and velocity ($mv^2/2g$). That's why for a given mass the latest 27-in. machine is so much more effective on some materials than the smaller 16-in. model; the energy available for size reduction climbs as the square of the velocity. It's easy to see how boosting peripheral speeds from 15,000 ft. per min. tops for the 16-in. unit up to 28,000 ft. per min. obtainable with the 27-in. mill would extend the range of materials that could be handled.

▶ **Uses Growing**—Typical of the new applications opened up by this larger machine is size reduction of polyvinyl chloride resin.

One manufacturer was rejecting up to 35% of resin material being produced because it wouldn't pass through 80 mesh. By passing 4,200 lb. per hr. of resin through the 27-in. Entoleter unit running at 25,000 ft. per min. 95 to 98% acceptable resin is produced. There is no gumming of the resin because with friction absent heat rise is small.

Other applications: defibrating short fibered asbestos from a density of 16 lb. per cu. ft. to 10 lb. without degrading the fibers; mixing insecticide, cutting batch mixer time from 30 to 5 min.; reducing size of Glauber's salt used for manufacturing cellulose sponge; reducing size of catalyst and ground cork; grinding at low temperature by injecting liquid CO_2 into mix prior to grinding; deagglomeration and reduction of viscosity in starch-kaolin paper coating slurries.

Large 27-in. Entoleter is designed to take either 7.5-30 hp. Varidrive or 60-16 hp. standard motor. Top speed is 3,850 rpm.—**Entoleter Div., Safety Car Heating & Lighting Co., Inc., P. O. Box 904, New Haven, Conn.** 256A

Equipment Cost Indexes

	March 1955	June 1955
Industry		
Av. of all	186.2	188.1
Process Industries		
Cement mfg.	178.4	180.2
Chemical	187.1	189.0
Clay products	173.2	175.0
Glass mfg.	176.8	178.6
Paint mfg.	180.1	181.9
Paper mfg.	180.4	182.2
Petroleum ind.	183.7	185.6
Rubber ind.	186.1	188.0
Process ind. avg.	184.2	186.1
Related Industries		
Elec. power equip.	188.9	190.8
Mining, milling	188.0	189.9
Refrigerating	206.8	208.7
Steam power	176.3	178.1

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See *Chem. Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1955, pp. 178-9 for annual averages since 1913.

Vibrating screen now on the market is especially suited for dewatering high capacity loads and sizing of material where headroom is limited. Built in sizes from 4 by 8 ft. to 6 by 20 ft. with either one or two decks.—**Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.** 258A

Wire filter cloth with more than 200,000 openings per sq. in. is believed finer than any other woven wire cloth, yet stronger. Can be woven in any weavable metal and in any mesh, has excellent flow characteristics and long life.—**Unique Wire Weaving Co., Inc., 762 Ramsey Ave., Hillside, N. J.** 258B

NOW!

Electronic LIQUID LEVEL CONTROL by FISHER®

Fisher Governor Company widens its scope of liquid level measurement and control with the Fisher "Belmont Series" of capacitance type electronic liquid level controllers.

The "Belmont" can be used on most non-adhesive liquids—chemicals, oil, water, refrigerants, liquefied gases. Operating temperature ranges of the sensing elements are from 500° F. to -425° F. Operating pressure range is vacuum to 50,000 psi or higher.

Only two simple adjustments for liquid and differential control.

Fisher Governor Company has purchased the Thermo Instruments Company, Belmont, California, which has manufactured and marketed the "Belmont" liquid level control the past ten years.

Write for Bulletin F-100

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

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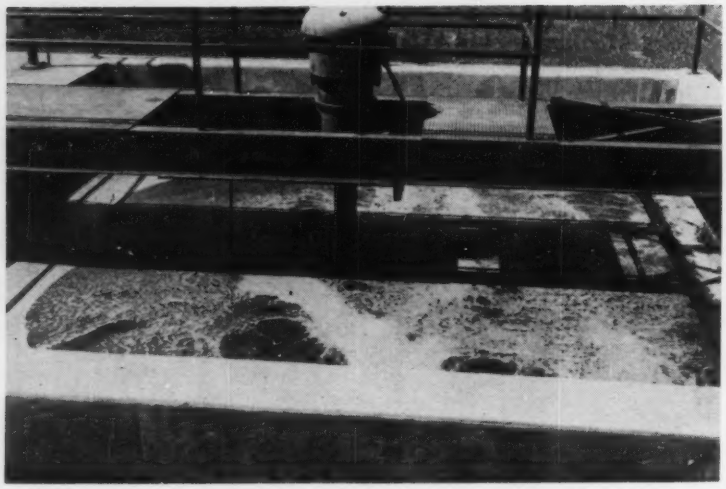
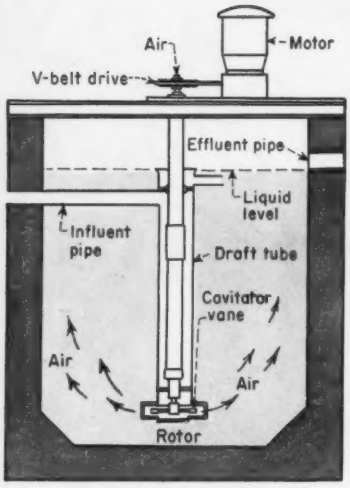
FISHER

Our 75th ANNIVERSARY



GAS BUBBLES etch liquid surface to highlight even dispersion in tank.



LIQUID meets gas at rotor tips.

Cavitation Steps Up Gas Dispersion

Faster, more complete dispersion of gas in liquid is claimed for a new mechanical system. Credit is given to combined use of cavitation and draft-tube circulation.

So outstanding has been the success of the Cavitator system in aerating industrial waste and sewage it is now being offered as a process tool.

Boasting a transfer efficiency of 35% the Cavitator uses only 120 cu. ft. of air per lb. of B.O.D. removed when handling domestic waste with an initial B.O.D. of 220. Other types of equipment require 800 cu. ft. of air to produce similar results.

Further proof of effective gas-liquid contacting is found in dissolved oxygen readings taken in an 8,000-gal. tank equipped with a 5-hp. unit delivering 17 cfm. All oxygen was removed from the tank contents at the start of the test and readings were recorded continuously at various levels. After three minutes of operation a dissolved oxygen reading of 5 ppm. was noted at a point 9 ft. below the center of the rotor.

► **Why So Effective**—The Cavitator produces gaseous diffusion under reduced pressure. Gas is exchanged rapidly and continuously between the gas bubbles and the surrounding liquid.

Oddly enough, the mechanism of rapid exchange is fostered by cavitation, a long-time bugaboo of liquid pumping and flow systems that lowers efficiency. Yet designers of the Cavitator have turned cavitation to good use to boost the efficiency of gas dispersion.

When gas bubbles are formed in a body of water or liquid, that layer of liquid immediately surrounding the bubble becomes saturated rapidly with gas. Diffusion into the main body is slow, however. It's said the Cavitator strikes at this weak point in the mechanism, producing a dynamic condition at the interfacial surfaces so that new surfaces are presented continually for the gas to enter.

• **How It's Done**—In the Cavitator system gas is dispersed mechanically by agitating the liquid with sufficient force to produce regions of cavitation. Then the gas to be dispersed is introduced into these regions.

The equipment consists of a hollow-bladed impeller mounted on a hollow shaft below a draft tube. Underneath the impeller is a baffle plate to control the flow path.

As the rotor revolves, gas is drawn down through the hollow shaft and discharged into the liquid through the tips of the rotor vanes. Many fine gas bubbles form and ascend through the liquid to the surface. Thorough circulation is obtained by using a draft tube.

► **Performance Controlled**—To obtain optimum results the following variables must be balanced: diameter of rotor, number of rotor blades, speed of rotor and hydrostatic head or rotor submergence.

With the proper balance of these variables the Cavitator will disperse 4 cfm. of air or gas per horsepower at 7 ft. submergence and 620 rpm.

While admitting some similarity between the Cavitator and mechanical flotation cells the manufacturer points out that this is primarily because both operate on atmospheric air and use impellers. There is a big difference between

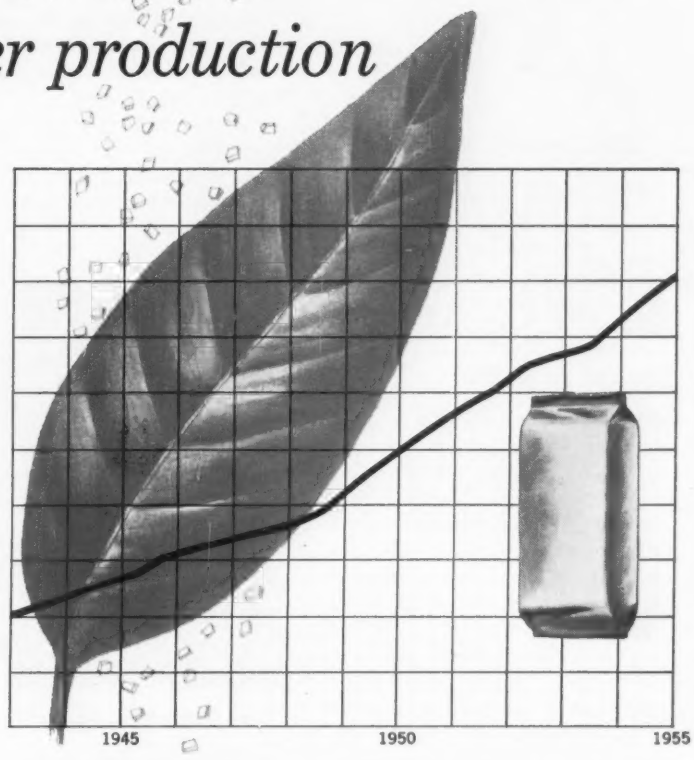
FLUOR

Phosphoric Acid Plants —your key to profitable P_2O_5 fertilizer production

Fluor-designed phosphoric acid plants, utilizing the low-cost St. Gobain-Union Chimique Belge process — used with outstanding success in Europe — can improve the profitability of your operations in the rapidly expanding fertilizer industry.

If you are now producing basic raw materials and seek new outlets, or if you are already part of the vital fertilizer industry and want a broader line of products, investigate this newest method of supplying P_2O_5 to the ever-growing agricultural market.

Your inquiries are welcome. Send today for Fluor's latest brochure on phosphoric acid and phosphate fertilizer plants . . . or contact the Fluor District Office nearest you.



Use of agricultural phosphoric acid which has been increasing sharply since the end of World War II . . . continues to climb.

THE 5 REASONS WHY FLUOR—ST. GOBAIN U. C. B. PLANTS ARE YOUR BEST INVESTMENT

ECONOMY . . . lower initial investment, lower operating cost potential.

CONVENIENCE . . . plant can be shut-in as long as 24 hours without "dumping" or costly reworking of material in process.

SIMPLICITY . . . fewer pieces of equipment to operate and maintain.

FLEXIBILITY . . . can use entire range of H_2SO_4 concentrations from 78 to 98%.

COMPACTNESS . . . Fluor-St. Gobain-Union Chimique Belge phosphoric acid plant occupies less space.

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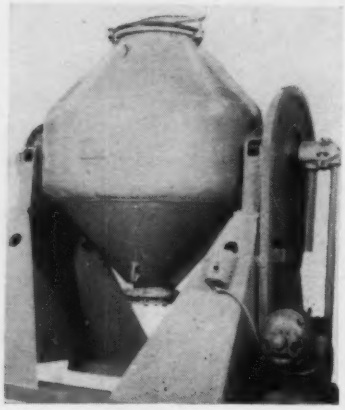
types of impellers and the method of introducing air or gas into the fluid. And this difference is claimed to be all in favor of the Cavitator.—**Yeomans Brothers Co., 1999 North Ruby St., Melrose Park, Ill.** **260A**



Dryer-Blender

Scale model available for product testing.

Scale models of a glassed-steel conical dryer-blender now are available for product testing. One unit will be located at the manufacturer's mechanical research laboratory and a second unit will be used for test work in clients' plants.

According to the manufacturer, the new dryer can be used for handling every acid except hydrofluoric, and for alkalis up to pH 12. In operation, the dryer revolves slowly to provide rapid drying and blending. Hot water or steam is circulated through the jacket and a vacuum exhaust removes vapors.

It is said that experimental work done with these small units gives reliable information on results to be expected with various processing conditions on production-sized equipment.—**The Pfaudler Co., Rochester 3, N. Y.** **262A**

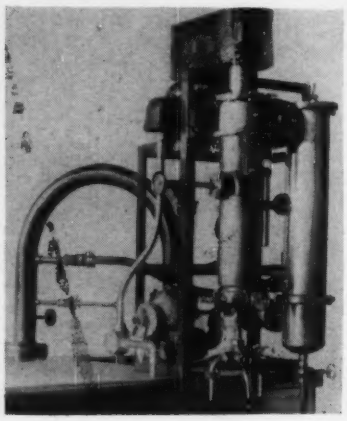
Horizontal Tank Filter

Adds features to speed up operation.

New features being built into a line of horizontal filters are claimed to speed up operation and simplify recovery or disposal of filter cake.

Included in the changes to horizontal-tank, pressure leaf filter are a quick-opening hydraulically operated and sealed door; and filter leaves which lift out and snap back into place without bolts. An optional vibrating attachment shakes off the filter cake, eliminating need for scraping or shaking by hand.

Standard features also include power or manual withdrawal of leaf assembly to expose all leaves completely, bottom outlet, air drying facilities and optional leaf spacing.—**Industrial Filter and Pump Mfg. Co., 5900 Ogden Ave., Chicago 50, Ill.** **262B**



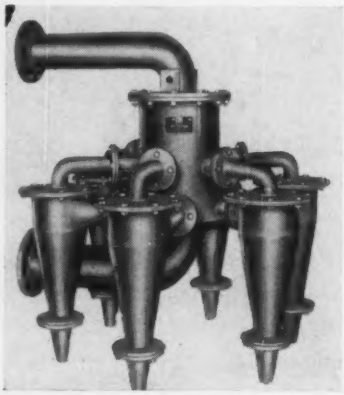
Small Evaporator

For pilot study of heat transfer processes.

A portable, laboratory model Turba-Film evaporator now is available for studying evaporation, single-step distillation, deodorization, heating, cooling and other types of heat treatment. Maximum flexibility has been built in to broaden the scope for pilot studies.

Built of Type 316 stainless steel throughout, the one square foot unit can utilize heating mediums up to 250 psig. and 700 F. Baffles in the steam jacket permit use of hot oil as a heat transfer medium. Rotor speed can be varied.

Evaporator can be supplied as an individual unit with stand or auxiliary condensing equipment, or as a complete packaged plant including vacuum equipment, feed pumps, discharge pumps and instruments, as required.—**Rodney Hunt Machine Co., Orange, Mass.** **262C**



Liquid Cyclone

Installed in clusters aims at higher yields.

New to the field of cyclone separation the CMI Clust-R-Clone concentrates the maximum number of cyclones in a minimum of space for utmost efficiency and operating economy, it is claimed. By grouping several cyclones around a central manifold not only is space saved but operation is coordinated for maximum efficiency.

Here are some of the design features of individual units: removable effluent chamber, effluent and feed mains equipped with standard pipe flange fittings, feed chamber and main body of wear-resistant alloy, discharge cone and orifice nozzle of replaceable wear-resistant alloy.

Arrangements of 4-, 8-, and 10-in. cyclones are available to handle a wide range of flow rates. Also offered are single 20-in. units.—**Centrifugal & Mechanical Industries, Inc., 146 President St., St. Louis 18, Mo.** **262D**

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

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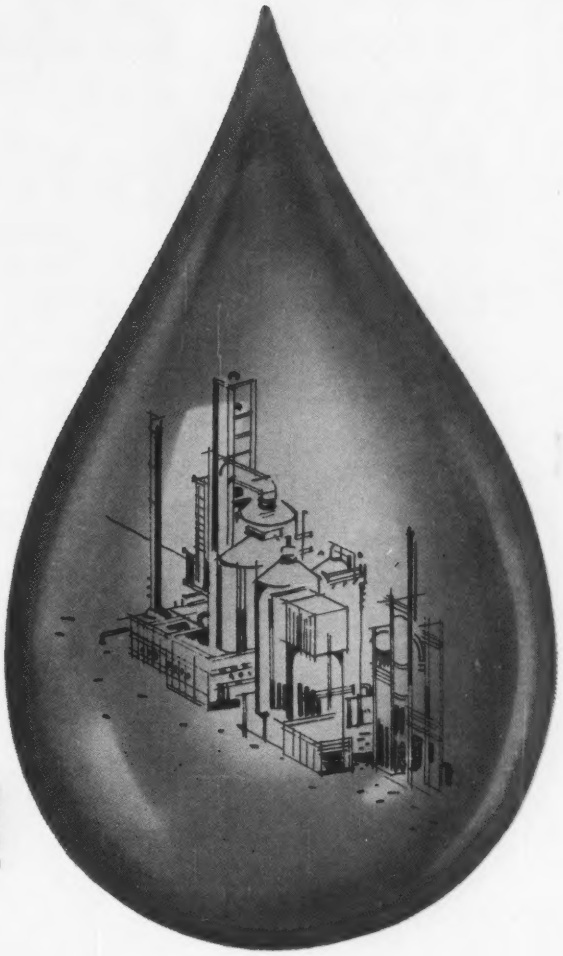
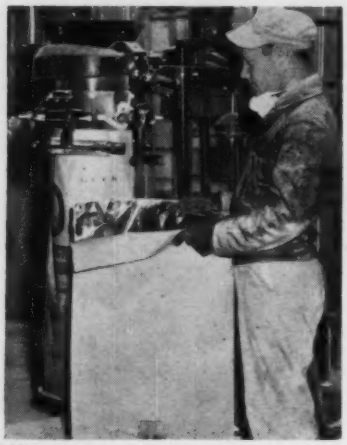


Completion of the Sinclair Aromatics Unit at Marcus Hook, Pa., Refinery means that a *new* and *dependable* source of supply of important petro-chemicals is now available to you. Designed for quantity production of high-purity Toluol, Xylol, ParaXylene and Higher boiling aromatics, this new Sinclair unit is a big step forward in meeting a basic industrial need.

If your manufacturing processes call for reliable supplies of these aromatic hydrocarbons, Sinclair is ready to serve you. For complete information call or write to . . .

SINCLAIR CHEMICALS, INC.

(Subsidiary of Sinclair Oil Corporation) 600 Fifth Avenue, New York 20, N. Y., Circle-6-3600



Bag Package

With foil interliner bars entrance of moisture.

A laminate of aluminum foil and paper now is used as one of the plies of multiwall bags for bulk packaging of hydroscopic chemicals, resins or other products requiring a high degree of moisture protection.

Under tests, the foil-kraft layer used as the inner ply of a multiwall bag is said to triple the protection against moisture gain over that provided by a polyethylene liner.

Reynolds Metals, producer of the foil, is packaging and shipping activated alumina in 100 lb. bags of this type. Godchaux Sugars, Inc., is using 50-lb. foil-lined bags to package its Camola animal feed.—**Hudson Pulp & Paper Corp., 477 Madison Ave., N. Y. 264A**

Solids Flow Valve

For handling flyash and other industrial dusts.

Designed to control flow efficiently during pneumatic transport of fine solid materials is the new line of type C materials-handling valves. They offer advantages of self-feeding, non-plugging operation with positive shut-off; maximum carrying capacity; minimum frictional wear and ease of maintenance.

By using these valves higher material concentrations can be handled in the piping system, permitting smaller diameter transport piping to be used. Wear is minimized because material is transported at maximum concentration over the full area of the pipe.

Type C valves are controlled with either air, electric, remote or manually.—**The Allen-Sherman-Hoff Co., 259 East Lancaster Ave., Wynnewood, Pa. 264B**

Electric Vehicles

For versatile, low-cost industrial transportation.

Two new electric vehicles for industrial use are the Mustang delivery model for light hauling jobs and the Mustang trucker for carrying loads up to 1,500 lb. Manufacturer claims the vehicles show automotive-quality engineering with all parts, including wheels, easily removable for quick maintenance. Operation cost is 5-15¢ per day.

Trucks will operate for more than 12 hr. on six batteries that are recharged overnight on 110 v. An exclusive for electric vehicles is full elliptic spring suspension on all wheels.—**Laher Mustang Mfg. Co,. 2615 Magnolia St., Oakland 7, Calif. 264C**

Screw Feeder

Delivers dry solids at uniform, accurate rate.

For feeding powdered dry solids to process the Vibra Screw Feeder offers uniformity of flow within ±1% by actual weight. Either amorphous or pulverized crystals, free-flowing or sticky, can be handled with equal precision.

Secret of the Vibra Screw's uniform action lies in use of density control along with volumetric metering and vibratory flow to completely fill and empty the measuring element.

The feed screw is mounted on a vibrator so that the entire screw assembly can be vibrated without noise or wear. Hopper feeding the screw is vibrated separately and at a different frequency and amplitude than the screw. This assures that a constant level of material will lie over the screw. Combined with constant vibration and retention time in the screw intake chamber this feature keeps material entering the screw at uniform density.

Feeders can be furnished in any size from oz. to tons per hr. with a feed range of 30 to 1. Two simple change parts, available as extra equipment, extend this range to 200 to 1.—**Vibra Screw, P. O. Box 25, Glen Ridge, N. J. 264D**

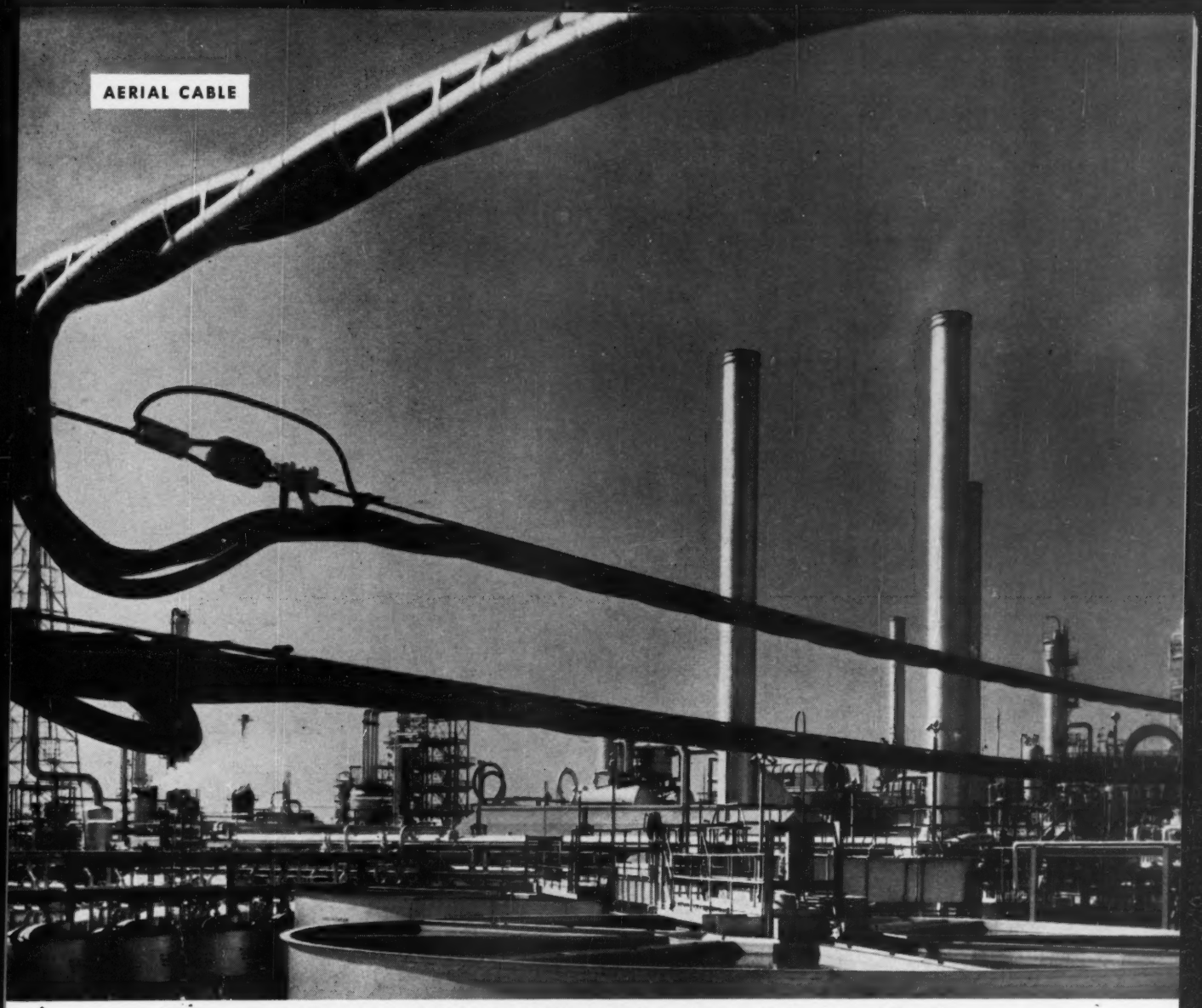
Molded Pallet

Lowers operating costs of materials handling.

Weighing only 28 lb. a new type materials handling pallet molded of fibrous-glass-reinforced polyester resins will support 3,000 lb. Unit resists wear, impact, abrasion, oils, grease, acids, alkalis and steam sterilization up to 325 F.

Nine hollow legs molded integrally with the platform permit a fork truck to approach from any of the four sides. For heavier than usual loads two pallets can be nested together to give nearly twice the strength. One hundred of these pallets can be nested and stacked in a space of only 102 cu. ft. and a height of 7 ft. 8 in.

A range of colors is available to identify different cargoes and help prevent accidental loss. Color is molded right into the pallet and is safe from scratching or rubbing off.—**Firmline Products, Inc., Midland Park, N. J. 264E**



NEITHER STORM NOR HEAT NOR CORROSION knocks out ANACONDA's 3-conductor 15kv self-supporting Aerial Cable—shown here at Shell Oil's modern new refinery at Norco, La.

GO UP TO BRING COSTS DOWN

—with AnacondA Aerial Cable

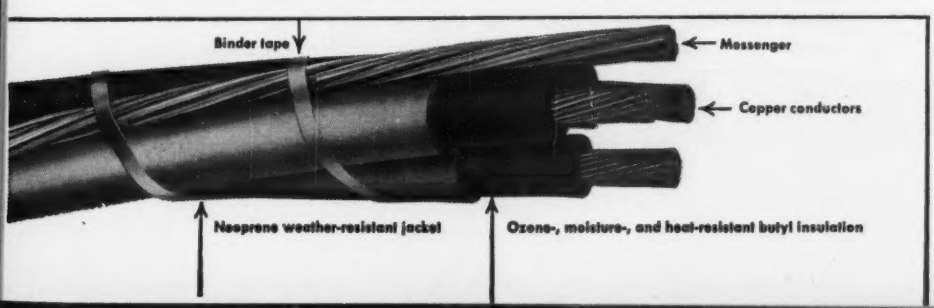
When new power is needed or when old circuits must be replaced quickly and at low cost—more and more plants are turning to ANACONDA Aerial Cable.

In plants where the maze of pipes and other underground structures often make installation of ducts or buried cable costly or difficult. This cable solves the problem.

It's fast, easy to install—particularly in crowded areas. No special ducts or crossarms or insulators are needed. Even in open areas, this rugged, neoprene-jacketed cable costs much less than buried systems.

You can see that it is neat. It is equally safe . . . and reliable!

Today's finest aerial cable! Type AB butyl insulation gives ANACONDA Aerial Cable the finest performance record. For the full story, call the Man from Anaconda today. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York. 86279



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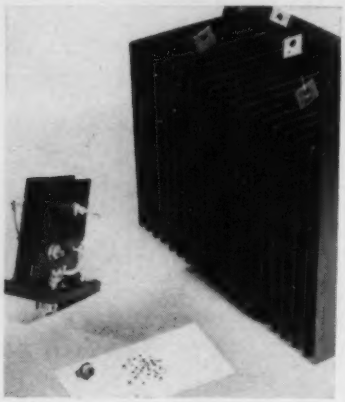


Power Rectifier

Made of silicon sets entirely new level of performance.

A tiny new electronic device made of extremely pure silicon shows promise of reducing power costs on a large scale in many industries. It converts alternating current to direct current providing 5,000 times more current than conventional rectifiers of the same size.

Silicon rectifiers are expected to have an almost unlimited life span; will be able to operate continuously up to 400 F. Efficiency is claimed more than 98% of the theoretical limit.

Shown above is a silicon rectifier on the left and an equivalent selenium rectifier on the right. Active elements are four wafers such as those on the paper in the foreground. These do the rectifying work of the twenty selenium coated fins on the big rectifier.

Applied to large sizes the silicon rectifiers may provide entirely new current and power possibilities for industry. Space saving will be of major importance.–**Bell Telephone Laboratories, 463 West St., New York 14, N. Y.** 266A

Enclosed D.C. Motors

Now have brushes that withstand silicone vapors.

A new type of carbon motor brush enables use of silicone insulating components in totally enclosed d.c. motors and generators.

Prior to this development silicones could not be used on this type of machine because of short brush life. Yet silicones are needed to withstand high operating temperatures.

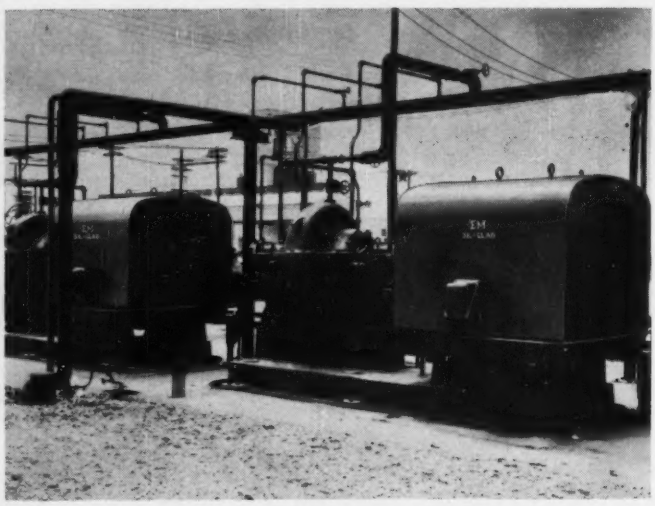
However, under high temperature the concentration of silicone vapor inside the enclosure caused brushes to dust away very rapidly. Brush life was short and the carbon dust collected in the windings and lowered the insulating value at this point.

New Grade N-2 and N-6 brushes withstand this effect to give long operating life.–**National Carbon Co., Div. of Union Carbide & Carbon Corp., 30 East 42nd St., New York 17, N. Y.** 266B

Liquid-tight flexible conduit connector now available for diameters of 2½, 3 and 4 in. Fitting accommodates any flexible conduit spiral because of integral, threadless grounding cone; may be installed without disassembling.–**Thomas & Betts Co., 2838 Butler, Elizabeth, N. J.** 266C

Variable speed pulley rated for ¾ hp. offers simple design for low cost and maintenance. Oil-impregnated bronze bearings eliminate need for lubrication. Pulley delivers 2¾ to 1 speed ratio using an "A" belt, can be reverse mounted. – **Lovejoy Flexible Coupling Co., 4840 West Lake St., Chicago 44, Ill.** 266D

Rerated line of TEFC motors, 7½ to 100 hp., features six-layer insulation using the latest plastic insulation and plastic-coated wire. Rib-type cast iron frame. Fan equally efficient rotating in either direction.–**Century Electric Co., 1806 Pine St., St. Louis, Mo.** 266E



Protection Built-In for Motors on Gulf Coast

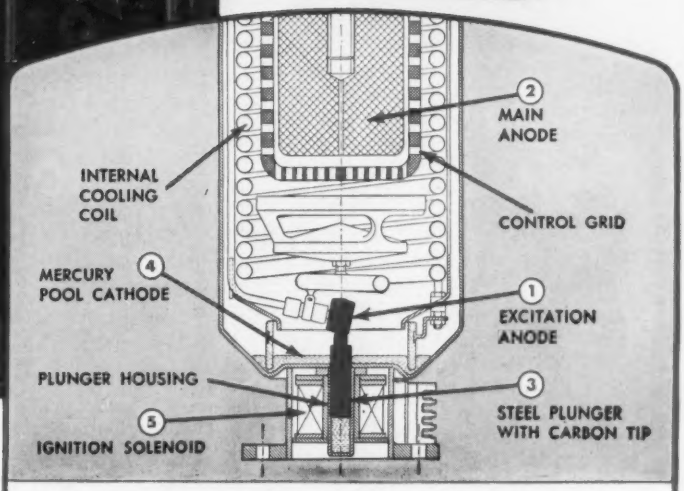
Silicone-type materials protect these pump drive motors against salt air and moisture in a Gulf-Coast chemical plant. Motor has a number of advantages over TEFC motor including lower cost, easier maintenance, and greater resistance to internal corrosion. Armature coils are insulated with silicone rubbers, tapes and varnishes. Metal surfaces, inside and out, are protected by baked-on silicone finishes. Air-borne particles are removed from the ventilating air stream before they can reach the inside of the motor. Rated 450 hp., 1200 rpm.–Electric Machinery Mfg. Co., Minneapolis 13, Minn. 266F

Here's the Rectifier That Needs

No Delicate Adjustments

This 1000-kw, 6-tube excitron rectifier is typical of units used for heavy-duty service in many industrial plants.

ALLIS-CHALMERS
Mercury Arc Rectifiers



Unique Plunger Starts Continuous Excitation

The excitron tube has an excitation anode ① in addition to the main anode ② . With the excitation circuit de-energized, the steel plunger ③ floating in the mercury pool cathode ④ makes positive contact with the excitation anode (as shown).

When the excitation circuit is energized, the ignition solenoid ⑤ pulls the steel plunger ③ away from the excitation anode ① and under the mercury pool cathode ④ , thus drawing a dc arc and forming the cathode spot, which makes conduction of load current by the tube possible.

If power is interrupted the plunger will float up, contact the excitation anode and automatically re-establish the excitation arc when power is restored.

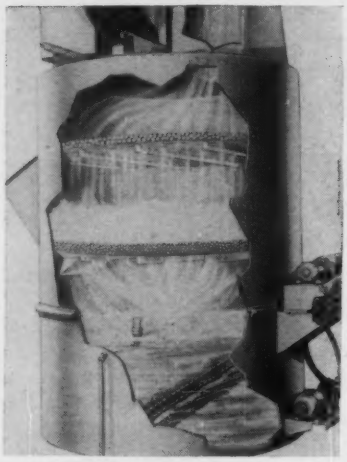
LITTLE MAINTENANCE IS NEEDED with Allis-Chalmers excitron-type rectifiers. Excitation of the excitron rectifier is continuous, while other types of rectifiers require re-ignition 60 times a second.

Since it is more difficult to start a rectifier arc than to maintain it, the excitron rectifier is much less likely to lose excitation during operation. Momentary dips in supply voltage which are encountered in many supply systems have no effect on the continuous excitation arc.

Years of operation in hundreds of installations have proved the reliability and ease of operation of Allis-Chalmers mercury arc rectifiers. You can get complete information from your nearby A-C office. Or write Allis-Chalmers, Milwaukee 1, Wis.

A-4581

ALLIS-CHALMERS



Dust Collector

Using bed of wet glass spheres is 99.7% efficient.

Basically, the new Hydro-Filter is an air scrubber where dust-laden air flows counter-current to water through beds of glass spheres. Efficiencies up to 99.7% have been reported on products such as Western Bentonite, 3-4 micron carbonyl iron and optical dust.

Two factors are given credit for high collecting efficiency: good contact between air and water, and relatively long contacting time.

Dust-laden air is drawn into the Hydro-Filter through the air inlet on the left. First, the air strikes the surface of water in the settling tank leaving considerable dust. Then, deflecting upward it meets a rain of water droplets from the bed of glass spheres above.

Rising up through this bed the air is working against and intimately contacting a head of water on the bed. Once through this section the air passes through another falling screen of water dropping from the moisture eliminator bed. Clean, dry air leaves through the outlet at the top.

Explaining the action of the unit the manufacturer points out that a three-way particle separation takes place. Lighter particles that are not removed as air strikes the settling tank are eliminated by entrapment with falling water droplets, impingement on bubble surfaces and impingement on wetted glass spheres.

Hydro-Filter is available in 14 models ranging in capacities from 2,500 to 25,000 cfm.–**National Dust Collector Corp., Dept. CR, Machinery Hall Bldg., Chicago 6, Ill.** 268A

Differential Producer

With simple, low-cost design operates at absolute minimum head loss.

A new fabricated-insert Dall flow tube eliminates one pair of flanges found in the cast design. New fabricated design combines the proved advantages of the Dall flow tube profile and the insert-flange type of mounting.

The fabricated-insert Dall flow tube consists of a weldment of two tapered cylinders or cones leading into a flange from opposite sides. Upstream end of inlet cone is machined to provide a shoulder perpendicular to the stream and a sharp intersection with the turned inner taper which is carried to the throat.

At the throat the standard Dall slotted annulus and short cylindrical "flats" are provided. Outlet cone is machined only far enough to assure no interference with pressure sensing at that point. There are two piezometer connections for standard pipe.–**Builders Providence, Inc., Div. B. I. F. Industries, Inc., 345 Harris Ave., Providence, R. I.** 268B

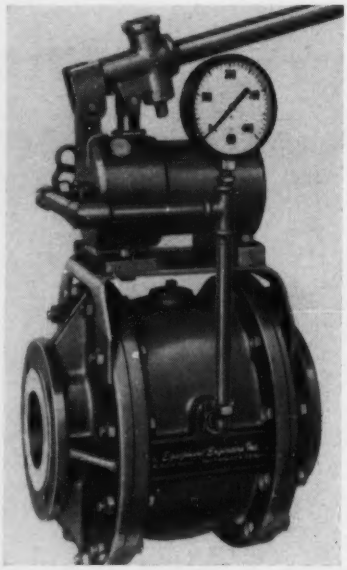
Tank Vent

Releases vapors upward yet blocks entry of moisture.

A new powdered bronze tank vent eliminates hazards of fire and explosion by allowing vapors to escape upward away from the venting area. Also, it acts as a flame arrestor, is impervious to water.

Equivalent open area of the vent is 175% of the 2-in. pipe area. Pressure drop is claimed almost negligible.

Although self-cleaning, vent can be unscrewed by hand and agitated in a solvent. The porous bronze material resists corrosion.–**OPW Corp., 2735 Colerain Ave., Cincinnati, Ohio.** 268C



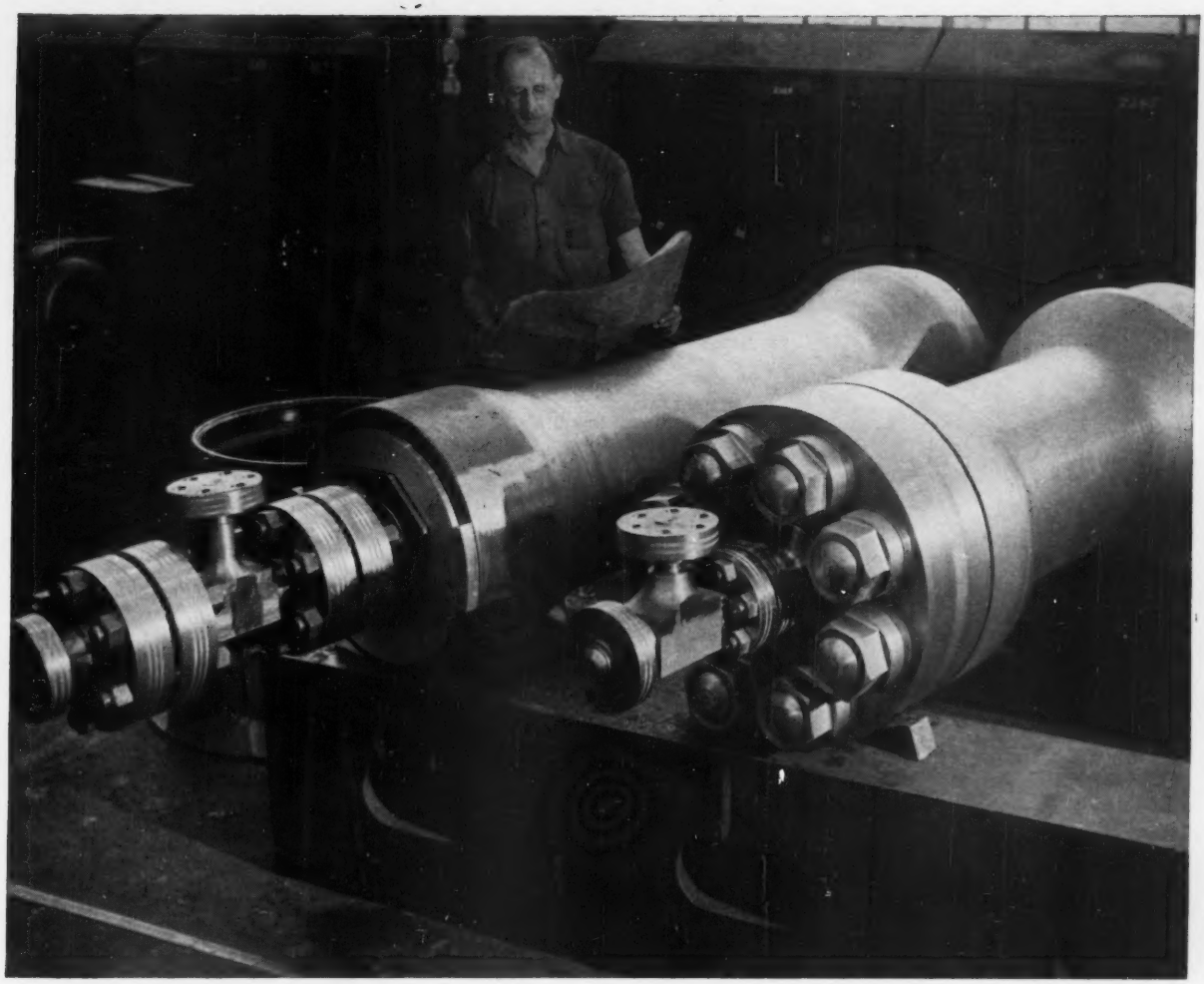
Slurry Valve

Controls flow by restricting rubber tube hydraulically.

Latest adaptation of the pinch-cock principle is the Krebs rubber slurry valve. With a design aimed at overcoming previous basic deficiencies of pinch valves this valve claims improved control over flow of abrasive and corrosive slurries. It has been proven out for two years on the abrasive slurries of a large copper producer.

Valve is built with a pure gum rubber liner encased within a high-grade casting. Flexible rubber orifice is adjusted hydraulically by a simple remote finger-tip control. To avoid loss of hydraulic fluid at high pressures, the valve's main body flanges are grooved and fitted with rubber O-rings.

Valve currently is available in 1½, 2, 3, and 4-in. sizes. Hydraulic control unit, including pump, piping, vessel, gage, etc., only costs an additional $76. From the user's viewpoint it is desirable to avoid dependence on air by using the integrated hydraulic control.–**Equipment Engineers, Inc., 41 Sutter St., San Francisco, Calif.** 268D



Little Vessels, Big Pressures

These little reactors, each with an ID of only 8 in., are two of the smallest forged vessels we've ever made. Their combined weight is less than 9 tons. The one at the left is 10 ft 10 in. long; the one at the right, only a little more than 9 ft. They are mere specks alongside some of the vessels we are called upon to build.

But they are little bulldogs, just the same. Their pygmy dimensions are scarcely an indication of their ruggedness. These two midgets were built to handle high pressures. The larger unit was hydrostatically tested in excess of 50,000 psi; the smaller, in excess of 30,000 psi.

If good things come in small packages, here's a case in point. You can imagine the care that went into the making of the steel, and into the forging, treating, machining, and inspecting.

Of course, we like to get our teeth into the big jobs, too. Bethlehem shops are equipped to build even the most massive vessels, and we've produced some real heavyweights. Giants . . . some of the biggest forged vessels you'll ever see anywhere.

The next time you're in the market, we'd like to discuss your requirements with you. Whether the job is small or runs to big tonnage, we can meet your specifications. Call or write us when we can be of service. Our engineers and shop personnel will co-operate in every way.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

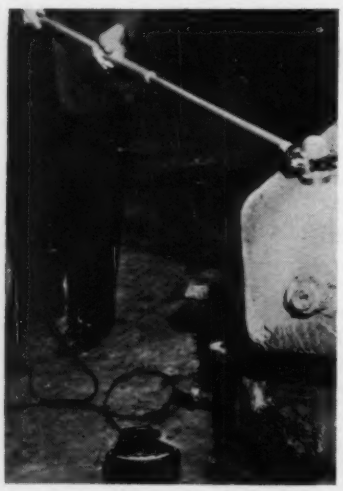
Photoelectric Control

Checks densities of gases and liquids.

New, ready-to-use photoelectric densitometer, set P4S, can eliminate smoke nuisance in industrial smoke stacks and ventilating ducts, monitor light transmission or optical density of liquids in chemical processing lines and regulate turbidity in water and sewage treatment.

Unit contains a light source, a photoelectric scanner and a control with meter. Two meter scales indicate "% transmission" and "optical density." Instrument will control at any light transmission value from 0 to 90%.

For smoke density control the unit automatically turns off blowers, closes dampers and operates multiple warning devices. When used in continuous process operations the densitometer will indicate and control the composition of fluids by monitoring their turbidity. **—Photoswitch Div., Electronics Corp. of America, 77 Broadway, Cambridge 42, Mass.** 270A



Surface Pyrometer

Measures hot surfaces surrounded by cooler air.

It looks like a microphone on a long pole but it is actually a portable surface pyrometer that accurately measures high surface temperatures of solids. Used for taking spot temperatures in a range from 100 to 2,400 F the Land surface pyrometer is accurate within 0.5%. Readings are obtained within 5 sec. after measuring head is placed on hot body.

Measuring head of the instrument is mounted on a telescopic arm which can be extended to a length of 9 ft. Normally a trailing lead connects the head to a portable millivolt meter that is calibrated in degrees of temperature.

Instrument head is concave to form a uniform temperature enclosure when it is placed on the surface of a hot body. Heavy gold plating inside the head creates a near-perfect reflector to actually reproduce surface conditions of the hot material.

Black body radiation trapped within the uniform temperature enclosure is sampled through a small fluorite window and measured by a sensitive thermopile.— **Fielden Instrument Div., Robertshaw-Fulton Controls Co., 2920 North 4th St., Philadelphia 33, Pa.** 270B

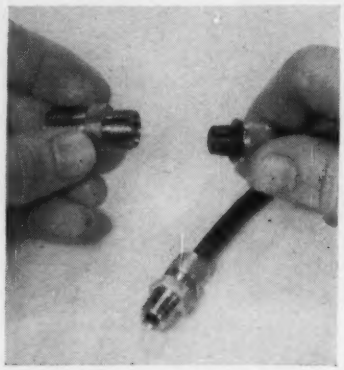
Flame Control

Two new electronic systems guard against flame failure.

New Flame-otrol combustion safeguard systems include the 1400 Series based on principle of flame rectification and 1500 Series using a lead sulfide photo-conductive cell that is responsive to infrared. Prewired control centers conveniently house combustion safeguards, pilot lights, alarms and all other components of a complete system.

The 1400 Series utilizes the ability of a flame to conduct a small quantity of electrical current and that the flow of electrons is greater in the downstream direction. In the case of gas firing, the flame is the medium for both conduction and rectification. The same circuit is used for oil firing but an emissive type photocell activated by flame luminosity provides the "flame-on" link.

In the 1500 Series the infrared sensitive cell acts as an agent for passing a "flame-only" type current when a flame is present. A flame failure is sensed instantly by the cell for fast "out-control" action for shutdown and alarm.—**Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill.** 270C



Tube Fitting

Flareless type for copper instrumentation lines.

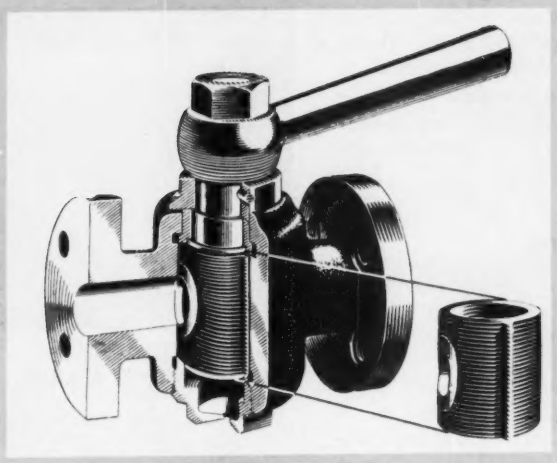
The Intru-lok fitting for instrumentation lines supersedes a heavier, more bulky style brass fitting furnished previously for this application. New fitting features easy, "in-true" tube entry and quick connection without disassembly of the fitting.

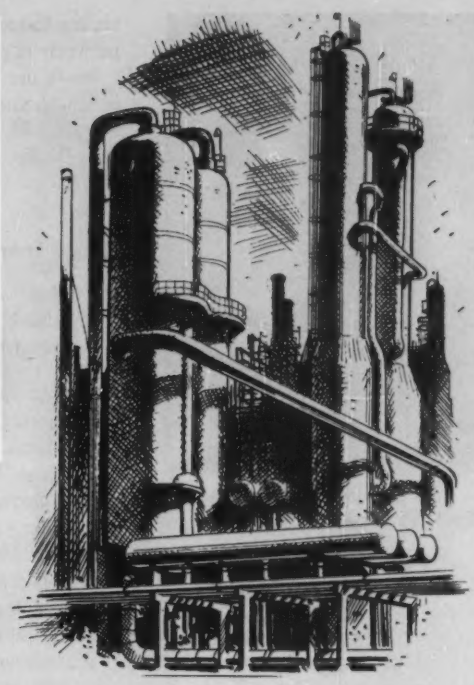
Tube is simply inserted through the nut and ferrule until it bottoms on the seat within the fitting body, then the nut is tightened. The wedging action of the nut causes the ferrule to bite into the outer surface of the tube wall, turning up a shoulder of metal to provide a leakproof, vibration-proof connection.

Fitting is available in all commonly used body shapes and in sizes for tubing ranging from ¼ to 1 in. O. D.—**Tube & Hose Fitting Div., Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.** 270D

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.





Tightness tells with the Klinger sleeve-packed cock!

In the last quarter of a century Klinger Sleeve-Packed Cocks have steadily replaced the old-fashioned asbestos-packed cocks with their limitations of working pressure, difficulty of repacking, and tendency to jam. They are available in a wide range of designs and sizes for all purposes and pressures and with the following outstanding advantages:—

Renewable "Klingerit" Packing Sleeves. Parallel-ground and non-jamming plug. Can be re-tightened during operation. Unobstructed straight-thru full bore.

Write for the Klinger Master Catalog, which describes the complete range of Klinger products, compressed asbestos sheet jointings and packings for every purpose, seatless piston valves, sleeve-packed cocks, reflex and thru-vision level indicators and rings and seals in natural, synthetic and silicone rubbers and other synthetic materials.

Klinger

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DISTRIBUTORS OR AGENTS IN PRINCIPAL CITIES

Pipe Wrap

Offers double-wrap protection from single-wrap application.

A new single-wrap coal-tar tape is used for pipe, pipe joints, fittings and couplings. Tapecoat-X can be single wrapped with only ½-in. overlap. Older methods require that slightly more than half the tape width be overlapped for effective protection.

Advantages claimed include greater coverage due to the single-wrap feature; easier application through an exclusive separator film which facilitates unrolling and automatically disappears in the application process; savings in time and labor and over-all economy of material cost.

Available in rolls of 2, 3, 4 and 6 in.–**Tapecoat Co., 1523 Lyons St., Evanston, Ill.** **272A**

Steel Member

Lightweight design for supporting floors and roofs.

Designed for modern lightweight buildings the Ambridge Standard Steel Joist provides ample freeway for pipe conduit and other utilities. It is intended for small industrial units and other light occupancy buildings.

Joists are formed from coils of heavy steel strip and round bars. First, the flat steel is cold rolled into special U-shaped sections. Then, the bars are bent into a zig-zag shape and resistance welded between upper and lower sections.

Joists are fabricated 3 to 40 ft. in length and in various widths and weights.–**U. S. Steel Corp., American Bridge Div., Ambridge, Pa.** **272B**

Roof Deck

Made of precast concrete has gained wide use in chemical industry.

A just-completed survey reveals that more than 13 million sq. ft. of precast concrete roof deck have been installed in new chemical plants during the mid-century decade ending last December. With a total of 505 plants so constructed the chemical industry ranked fifth both in total roof area installed and the number of installations.

Prominent reasons for using precast concrete roof deck include ease of installation, lower cost than a poured roof, durability, fire resistance, reduced maintenance and reduced insurance cost.–**Eden & Associates, 420 Superior Ave., N.E., Cleveland 14, Ohio** **272C**

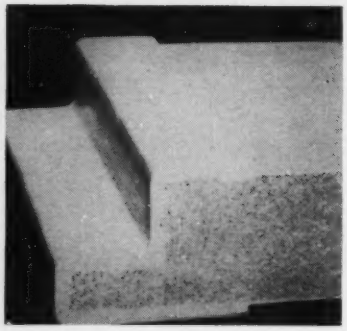
Protective Coating

Gives wide range protection to thermal insulation.

Moisture-resistant Lagz coating protects insulation from damage by abrasion or puncture. It assures high thermal efficiency and low maintenance costs.

Compounded of Neoprene, silicone rubbers and resins, Lagz coating is not affected by moisture, oils, brine, solvents, corrosive gases, chemicals and weathering. It has high mechanical strength, is nonflammable and non-toxic.

Medium viscosity Lagz No. 1 used on 85% magnesia, calcium silicate, felt, rock wool and asbestos can be applied by spraying, brushing or sponge. High viscosity Lagz No. 2 for low-temperature insulation such as cork, foamed plastics, glass fiber and cellular glass is applied by brush or trowel.–**West Chester Chemical Co., Box 39, West Chester, Pa.** **272D**



Construction Panel

For a wide variety of industrial uses.

Just developed and now undergoing field tests is a strong, lightweight, insulated plastic-sandwich construction panel. Also, it is moisture proof and corrosion resistant throughout.

Filling for the sandwich is Styrofoam expanded polystyrene with a density of 2 lb. per cu. ft. Polyester sheet reinforced with fibrous glass, either 0.018 or 0.032 in. thick, is used for facing.

Hasko-Struct panels have standard thicknesses of 1, 2, 3, 4, or 6 in. Standard width is 48 in. with lengths of 96, 120 or 144 in.–**Haskelite Mfg. Corp., Grand Rapids, Mich.** **272E**

Tank Lining

Restores corroded tank surfaces.

A new tank lining cement is said to restore corroded interior surfaces of large water storage heaters and steel tanks. Cost is one tenth that of installing a new tank. Extension of operating life may run to five or ten years.

Noteworthy among the advantages of C-17 Pre-Krete are lack of shrinking, cracking or high-temperature failure. It applies easily under normal temperature and atmospheric conditions; will set within a few hours.

Pre-Krete is packed in 95-lb. moisture-proof bags.–**Pocono Fabricators, Inc., East Stroudsberg, Pa.** **272F**

Here's How

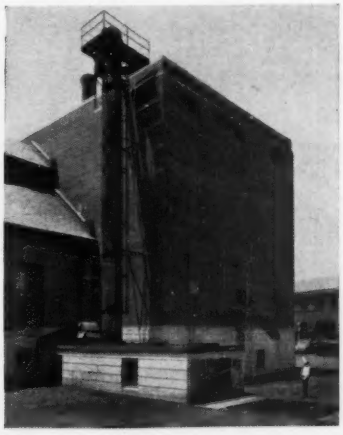
you can lower the cost of elevating

LINK-BELT will recommend the right bucket elevator from 13 types in 4 basic designs

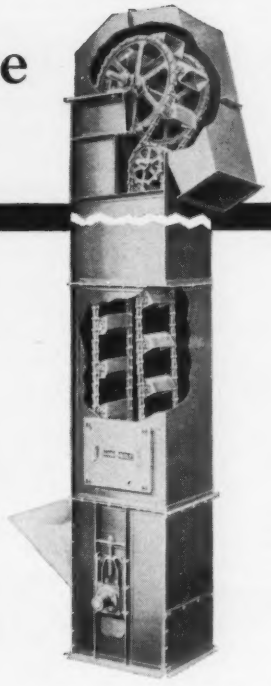
YES, not only does Link-Belt make bucket elevators for all types of material — there is specialization right down to spacing of buckets . . . the types of take-ups and hoods for utmost effectiveness. In addition, Link-Belt offers a wide range of buckets for further assurance of maximum efficiency in handling your materials.

Installation, maintenance and operating costs are low with Link-Belt Bucket Elevators. Rigid, jig-built casings are self-supporting requiring only occasional lateral tie-ins depending on height. You have quick access to both head and boot for periodic inspections. Simple screw or gravity take-ups maintain chain or belt tension always.

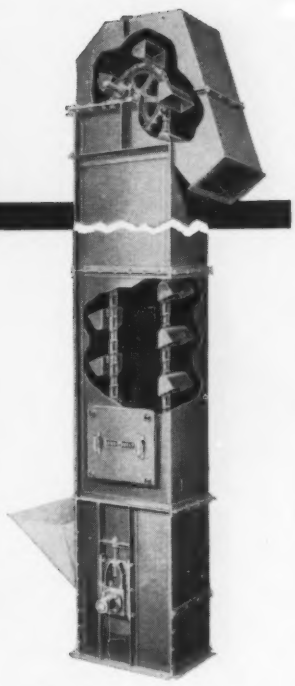
To be sure of a bucket elevator system tailored correctly for your needs, include Link-Belt in the designing of your next plant. Get in touch with a materials handling expert through your nearest Link-Belt office.



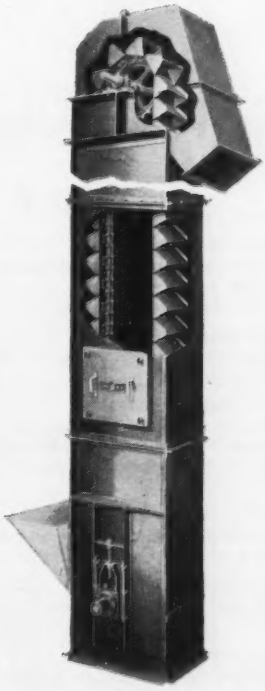
Link-Belt 75-ft. high bucket elevator lifts material from truck dump hopper to storage bin via screw conveyor. Casings need only occasional tie-ins depending on height.



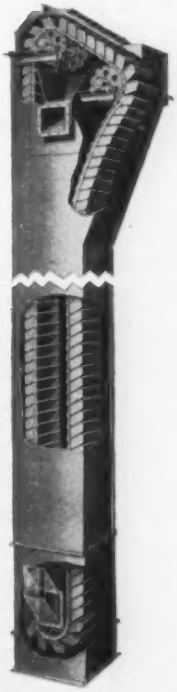
Positive discharge for light, fluffy and fragile materials or materials that have a tendency to stick to the buckets.



Centrifugal discharge for free-flowing, fine or loose materials with small to medium lumps.



Continuous discharge for range of materials — light to heavy, small to large, abrasive lumps.



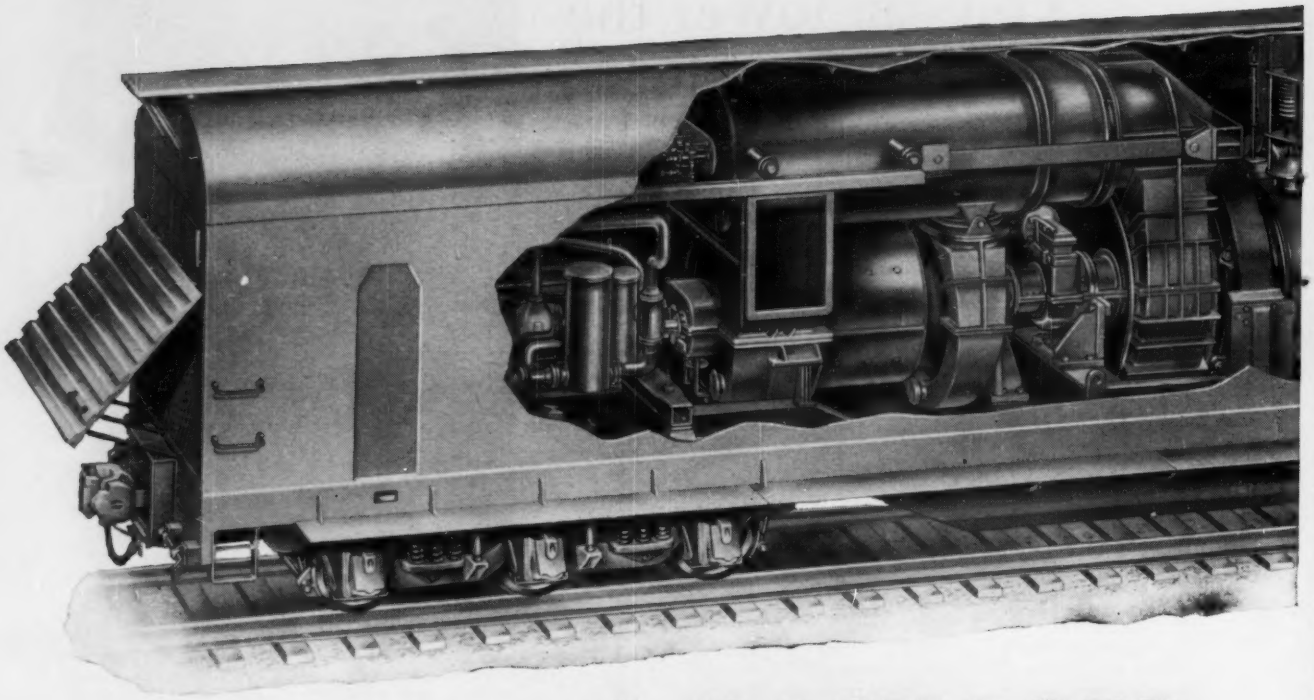
Internal discharge for gentle handling of small articles such as pellets, seeds, castings.

LINK-BELT

BUCKET ELEVATORS

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,786

Revolutionary Clark development in mobile power generation



A PACKAGED

KEY FEATURES

1 COMPLETELY SELF-CONTAINED
Requires only connection to fuel source and electrical load.
No water nor outside power needed.

2 ONE-MAN OPERATION
Simple, pneumatic controls. Complete, built-in, dead front switchgear.

3 MOVED AT HIGH SPEEDS
Can be hauled on regular passenger or freight train service. All components specifically designed for mobile operation. Special, heavy duty car.

4 QUICKLY PLACED IN SERVICE
No site preparation required. Operates on any reasonably level track.

5 3-POINT SUPPORT
Car flexing does not affect alignment of power unit.

6 DUAL FUEL OPERATION
Burns wide range of liquid or gaseous fuels simultaneously or individually.

7 SPLIT SHAFT DESIGN
No alignment problem. No step-down gears between turbine and load. No physical connection between turbines.

8 THERMO-ELASTIC DESIGN
Hot parts expand without stress. No bearing misalignment.

9 LONG LIFE — LOW TEMPERATURE
Minimum blade life of 100,000 hours.

10 AIR COOLED — NO WATER REQUIRED

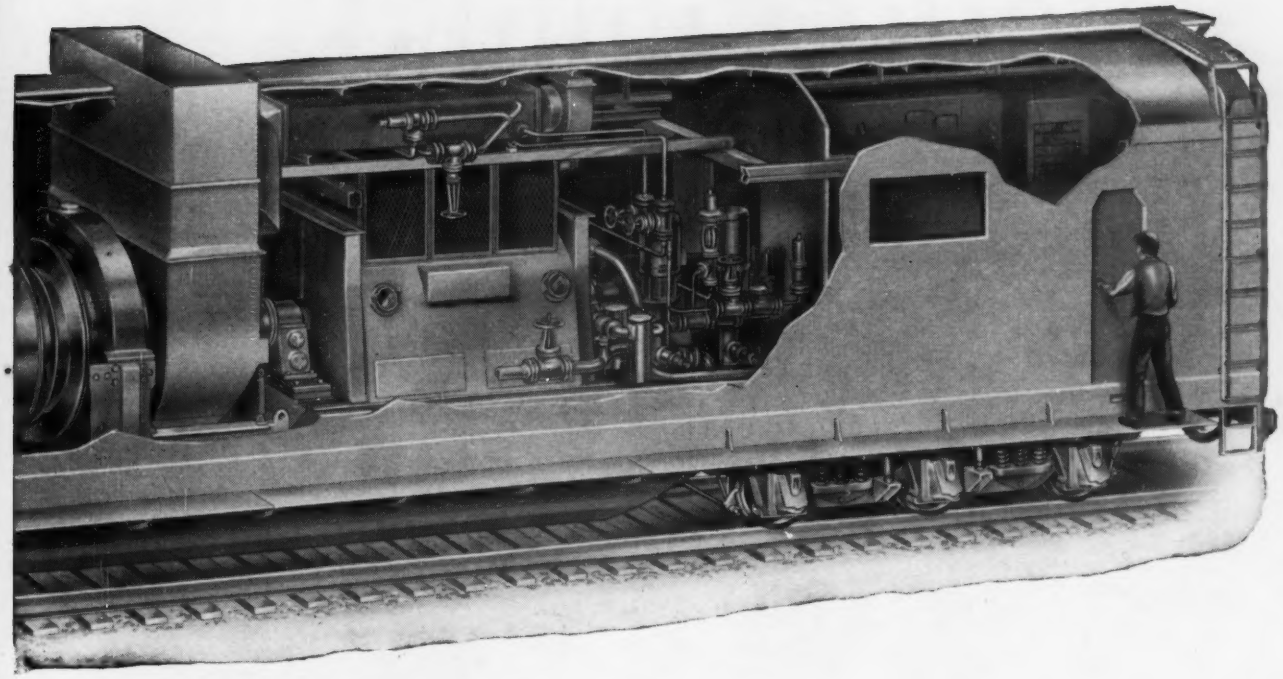
11 DUAL MULTI-STAGE HIGH AND LOW PRESSURE TURBINES

12 LIFETIME SINGLE COMBUSTION CHAMBER

13 MINIMUM RADIATION
All exposed surfaces cool enough to touch.

14 FLEXIBLE ELECTRICAL CHARACTERISTICS
Dual frequency. Operates in parallel with existing facilities or independently.

15 UNUSUAL ACCESSIBILITY
All parts readily accessible for rapid inspection and servicing.



5500 KW POWER PLANT

Completely self-contained in a single R.R. car

The Navy ordered it. Clark built it — a packaged 5500 KW mobile power plant completely self-contained in a single railroad car, for emergency use by the Bureau of Yards & Docks.

Featuring a completely new, Clark designed combustion gas turbine, driving a synchronous generator, the unit is specifically designed as a mobile emergency power station to supply a substantial block of power on short notice. Clearly, this is a development that offers many opportunities to the armed forces, civil defense, public utilities and industry.

Furthermore, the unique gas turbine which drives the generator is extremely well suited as a matching driver for centrifugal compressors serving the gas transmission, refining, process and other industries.

Clark engineers will gladly furnish details and discuss specific applications with you. Complete brochure mailed on request.

CLARK BROS. CO. • OLEAN, N. Y.

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CLARK ® — ONE OF THE DRESSER INDUSTRIES

TURBINES
ENGINES
COMPRESSORS

Civil Aeronautics Administration

Rain, Bugs Boost Pesticides

Easing drought and heavy infestations were the clinchers needed to make 1955 the best year for organic pesticides since 1951—or maybe the best ever.

Donald R. Cannon, Assistant Editor

This would have been a good year for pesticides, anyway. Even with ordinary crop levels and pest activity, 1955 figured to equal or better 1954, which, for organic pesticides, was the best since the peak year, 1951.

Then the three-year-old drought eased considerably, crops (and weeds) flourished, insects waxed fat and numerous, and the rush for pesticides was on.

Producers of organic pesticides may well find at year's end that they turned out better than 450 million lb. of organic pesticide chemicals in 1955, well over 1954's 418 million lb., and close to the 463 million lb. made in 1951.

Production this year could, in fact, be the best ever for organic pesticides—as much as 480 million lb.—if cotton infestations have persisted and insecticides have fulfilled their early promise.

The overall pesticide picture is not that engaging, however. All production, inorganic as well as organic, won't reach 1951's high-water mark of 660 million lb. The inorganics have retreated too far in the face of pressure from synthetic organics to expect that.

Production of copper sulfate, the inorganic leader, was down to about 80 million lb. for pesticide use in 1954—nearly 50% off 1951 and 10% off 1953 totals. It will probably slip further this year.* Calcium arsenate, a 40-million-lb. item in 1951, plummeted in three years to 3 million lb. Lead arsenate, at 15 million lb. in 1954, was down 40% from 1951. The latter, however, has been holding at that level for three years and might pick up a bit this year what with the urgency of the insecticide demands.

► **Demand Is There**—But organic pesticides are headed for a real good year. Even though we've three months to run there are four factors helping them along:

• Drought—easing up. This is most marked in the South and Southwest where it's been raining much more than expected, bringing the first relief in more than three years. Big crops and heavy weed growth have followed to spark pesticide demand.

• Bugs—plenty of them. Insects had themselves a field day this summer, especially in cotton-growing regions. Cotton consumes 30-40% of domestic insecticides. Insecticides, in turn, are two-thirds of the pesticide business. So cotton bugs are the one biggest factor in pesticide resurgence this year.

• Exports—sizable and growing. In 1954, 273 million lb. of pesticides left the U. S., 5% more than in 1953. Pesticide exports were up for the first four months of 1955, compared with last year.

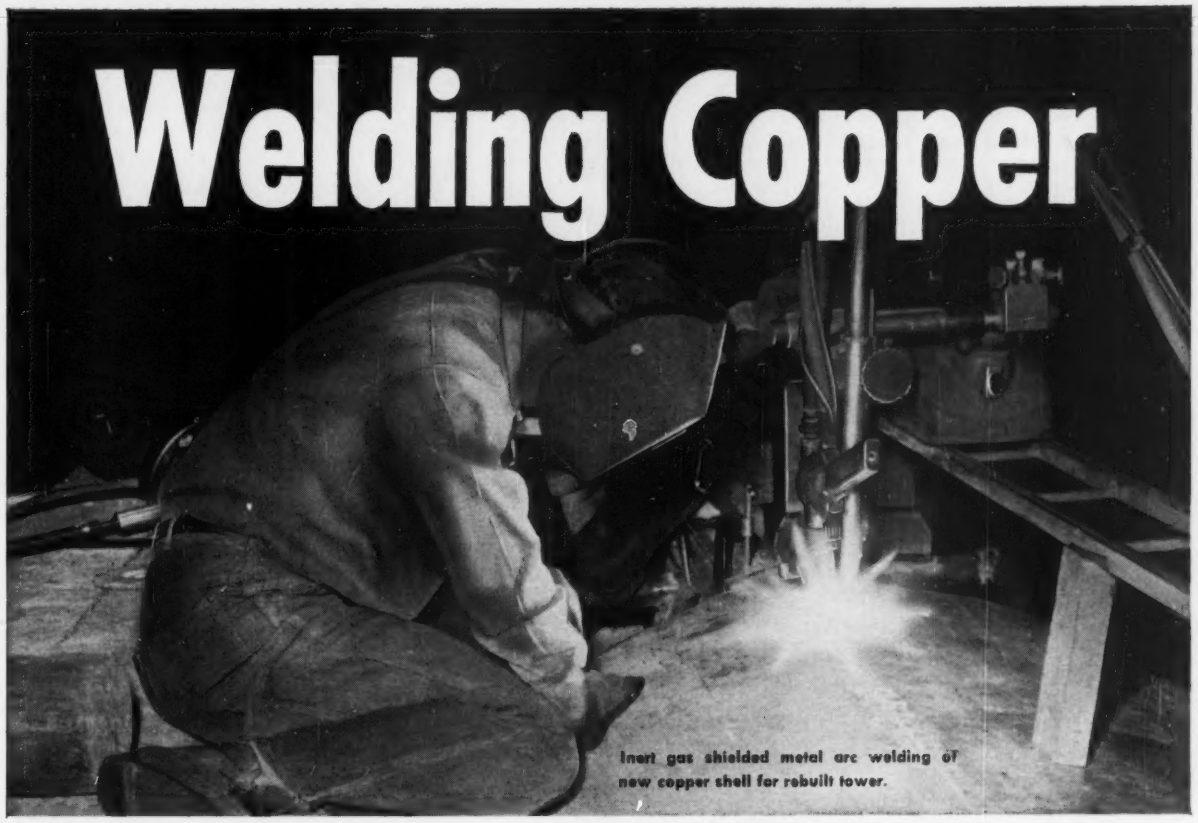
Herbicide exports in 1954 (14.8 million lb.) were 24% above 1953, 51% above 1952. The crop year 1953-54 saw more than 42 million lb. of DDT go abroad. Exports of "DDT 25% and over" for January-April 1955 were more than twice those of a year ago. Exports of BHC in January-April this year were almost three times above the first four months of 1954.

Continuing government purchases of pesticides for public health programs abroad, and decreasing dollar shortages in foreign areas should keep 1955 export volume above that of 1954.

• Cultivated acreage—limited.

* Copper sulfate is threatened more this year by one of the tightest metallic copper supply conditions in years—with attendant high prices—than by organic competition.

Welding Copper



Inert gas shielded metal arc welding of new copper shell for rebuilt tower.

SAVES 38% in materials and labor for joining

Some time ago, the Tennessee Eastman Company, Kingsport, Tennessee, a Revere customer, began to rebuild some of its copper stills or fractioning towers, which previously would have been silver-brazed. Revere's welding specialists were called in to see whether or not welding would be superior. Demonstrations were made to Tennessee Eastman engineers and shop personnel, with the result that welding was adopted. Actual experience in the shop shows a saving of 38% in materials and labor for joining, and a better job in every way. The welding method used is the inert gas shielded metal arc process.

Reconstruction of the towers was made to reduce the number of flanges. At the same time Tennessee Eastman changed from the flange joint tray construction to the inserted tray type and incidentally, reduced the number of gaskets with their accompanying maintenance problems. The trays are salvaged by shearing off the bolt hole circle and folding up the edges. The towers are some 45′ high, 6′ to 10′ in diameter, with a tray or bubble cap plate at specified intervals. Tennessee Eastman plans to rebuilt several towers a year in this economical way.

It will pay you as it did Tennessee Eastman to look into welding as a modern method of joining copper. Remember Revere is fully experienced in the most modern and efficient methods, and will collaborate with you on their application.

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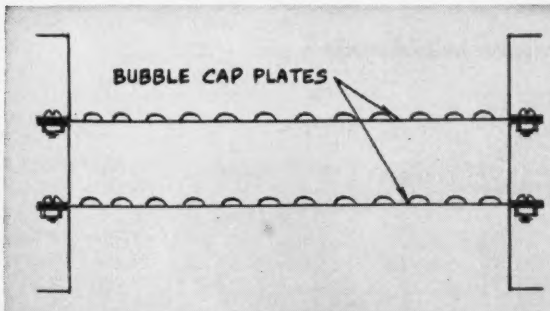
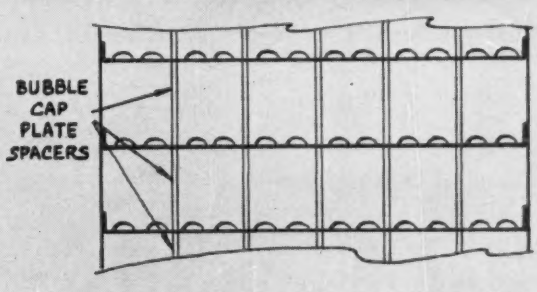
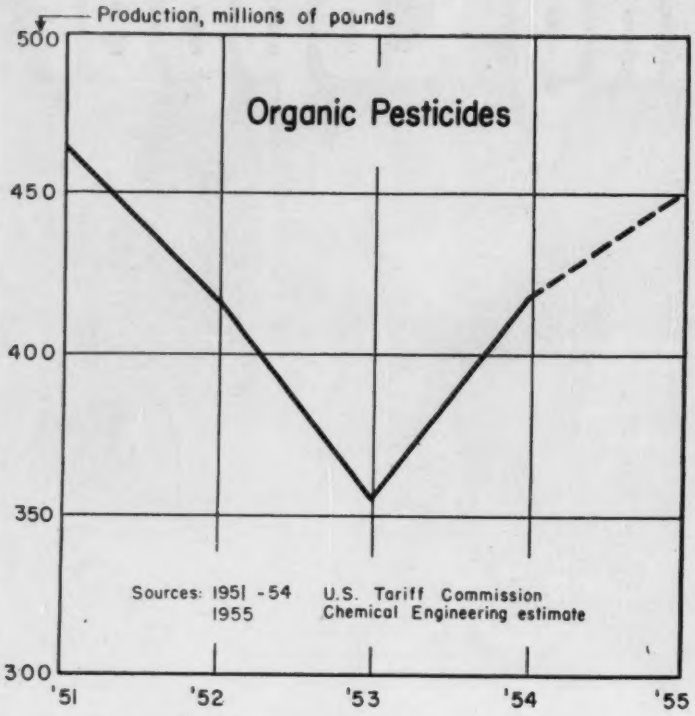


Section through old tower, showing bubble cap plates held in bolted flange.



Section through new welded tower. Bubble cap plates have had bolt holes sheared off, edges turned up. They are held in place by spacer rods.



U. S. Pesticide Consumption: Best in Years

(Crop year, Oct.–Sept., million pounds)

	1953–54	1954–55
BHC	48.6	63.0
DDT	45.1	65.0
2,4-D	26.5	28.0
2,4,5-T	3.0	3.5
$CuSO_4$	74.1	55.0
$CaAs_2O_3$	3.2	5.0
$PbAs_2O_3$	16.0	20.0

Sources: 1953-54—Dept. of Agriculture.
1954-55—*Chemical Engineering* estimate.

Recent restrictions on how much land he may till is making the farmer more careful of his crops, more inclined to use pesticides to keep his productivity high.

▶ **Production is Responding**–Rain, bugs, etc., naturally lead to stepped-up production of pesticides. Just how much is tied up in:

• Inventories–nominal. Carry-over stock of 26 major pesticidal chemicals in the hands of manufacturers was about 135 million lb. on Sept. 30, 1954, about 10% lower than on the same date in 1953. This inventory is considered quite normal and should help trigger a prompt production response to increased consumption.

• Prices – firming. This is really the tipoff on production incentive. With prices of such industry bellwethers as DDT and BHC moving up and holding at levels where some money can be made, production has been taking the cue. In August BHC was 0.75¢/gamma-unit-lb. and DDT, 27¢/lb.

▶ **Insecticides Leading**–Output of DDT for the first five months of 1955 was 22% higher than for the same period last year. If this trend continues–and it might even pick up what with cotton insect activity–look for 115-120 million lb. of DDT made in 1955.

BHC is much harder to predict. January-May production this year was only about half that for same period in 1954. The lag may be due in part to a rather high BHC inventory in 1954–almost equal to domestic consumption in 1952-53 or 1953-54. Despite reports of

INDEX: 1935 = 100

Business Activity

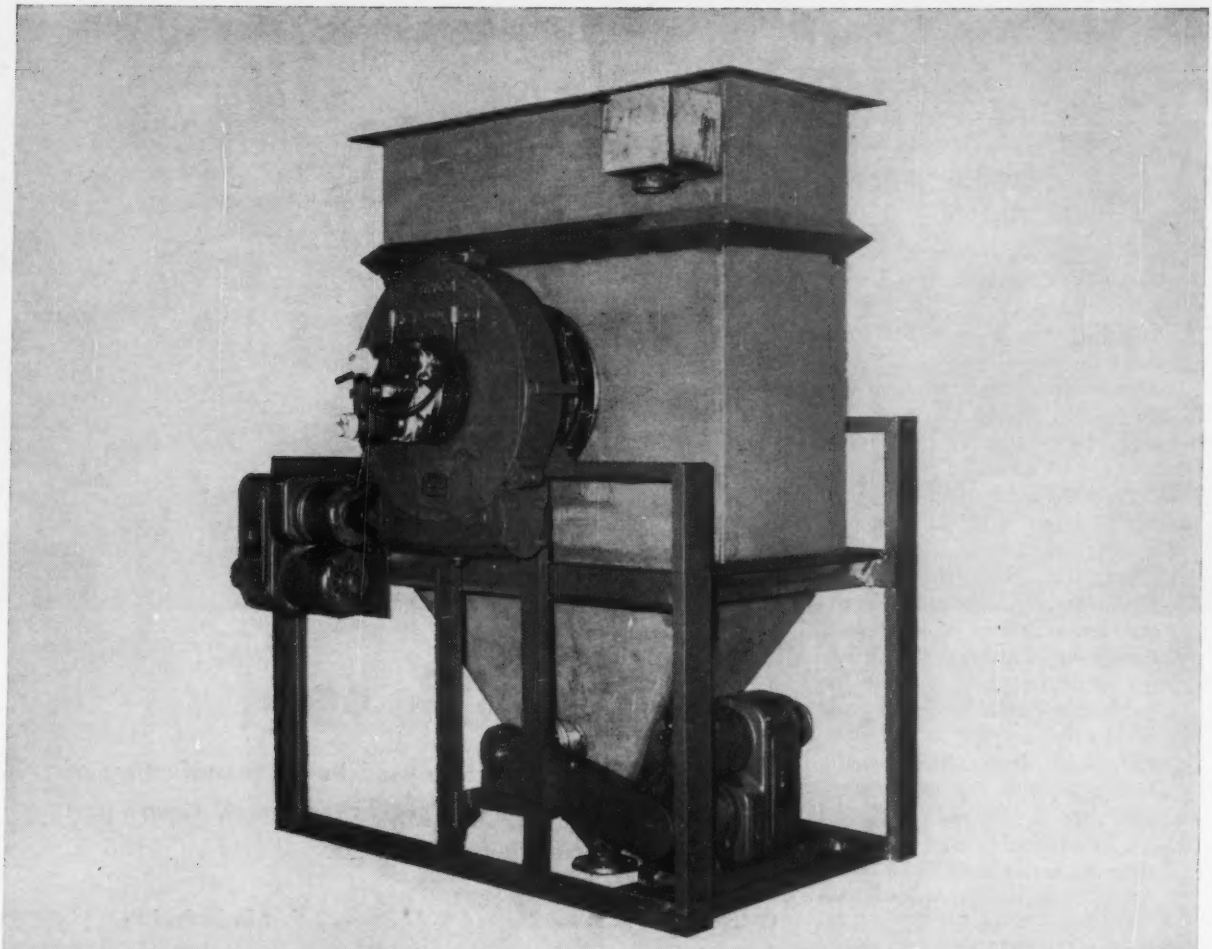
July	320.2

Chemical Consumption

June (preliminary)	290.9
May (revised)	311.0

Chemical Consumption by Industries

	June	May
Fertilizer	49.30	70.35
Pulp & paper	35.47	36.09
Petroleum refining	29.20	29.35
Iron & steel	17.88	18.94
Rayon	29.75	29.32
Glass	27.00	26.43
Paint & varnish	35.80	34.48
Textiles	10.19	10.59
Coal products	11.96	12.77
Leather	2.80	2.76
Explosives	9.45	9.40
Rubber	7.80	7.45
Plastics	24.25	23.07



Another Eimco Continuous Vacuum Filter

The machine pictured is built as two different machines. One contains a drum type filter with a top feed for drying sand or other crystalline materials. The other contains a disc type thickener filter which runs completely submerged. It is built with a large port for carrying the clarified product or filtrate and a small port arranged to admit a small amount of blow at the bottom sector for dislodging the thickened material so that it can be discharged at the bottom of the tank.

These are special filter applications and examples of developments in liquid-solids separation through filtration.

Eimco, with more than half a century of experience in serving the process industries, makes drum, disc, pan, pressure, plate and frame and tubular type filters with numerous attachments that can be applied to processing industries with difficult filtration problems.

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B-140

BHC in short supply this summer and despite its firm price don't look for 1955 production to equal 1954's. Make it 70 million lb. in 1955.

Consumption of other major insecticides – toxaphene, chlordane, dieldrin, aldrin, heptachlor–was 30-35% higher in 1954 than in 1953 despite drought conditions. Low stock levels of these chemicals was the result. Quickening insecticide demands this year should be getting prompt action from producers.

Production of malathion and parathion, up in 1954, should stay on the upgrade.

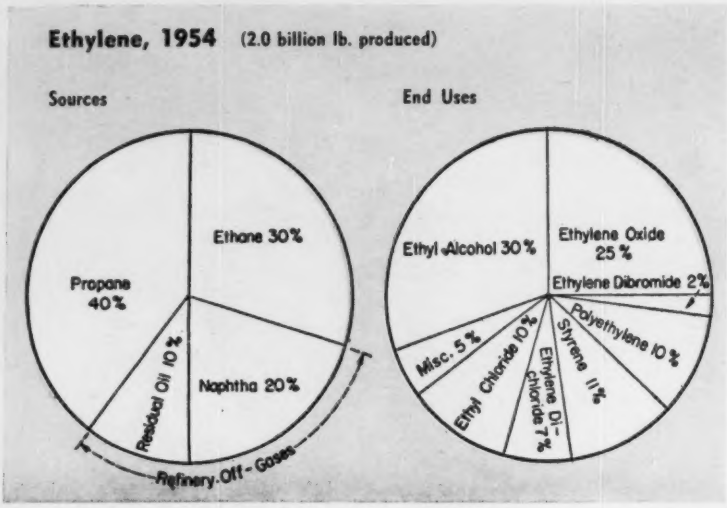
Systemic insecticides, while striking in their effectiveness, are several years away from big usage, even though one–Pittsburgh Coke's Systox (a trialkyl thiophosphate)–has just been approved by FDA for use on 11 edible crops.

▶**Herbicides Better, Too**–January-May production this year was up 15% for 2,4-D and 34% for 2,4,5-T. Drought relief will carry these to better than 1954 levels. About 35 million lb. of 2,4-D and 3-4 million lb. of 2,4,5-T will be produced in 1955.

Over 85 million lb. of these and other herbicides were used in 1954. What with more rain this season, output should be mostly up.

▶**Fumigants Look to Grain** – A very active market, fumigants attracted a production of 35 million lb. of chemicals in 1954. The two principal soil fumigants, D-D (dichloropropene-dichloropropane mixture) and ethylene dibromide, accounted for 15-18 million lb. and 8-10 million lb., respectively. The "clean grain" program, actively pushed at last by the Dept. of Agriculture and the Food and Drug Administration, will dictate use of large volumes of fumigants and repellants after the fall harvest.

▶**Fungicides Are Steady**–Inorganics like copper sulfate are sloughing off, new synthetic organics like captan and the dithiocarbamates are jumping in to fight fruit disease. Antibiotics may make their strongest bid this year but costs will still discourage most (e.g. about $50 an acre to combat pear blight, the biggest potential outlet).



Ethylene Has No Equal

Of all intermediates used in the manufacture of petrochemicals, ethylene is easily the biggest. Here's part II of our report on petrochemicals.

C. J. Matthew, R. F. Messing and R. L. James, Arthur D. Little, Inc.

Today's principal interest in ethane is as a source of ethylene, the basic intermediate used in the manufacture of some of the largest-volume petrochemicals.

Because of its versatility as an intermediate, ethylene has been one of the most rapidly-growing petrochemicals, increasing from a level of about 200 million lb. some 15 years ago to about 2 billion lb. in 1954.

Cracking of ethane and propane are the most important sources of ethylene, though gas oil is also used (*see charts above*). Ethane and propane come from natural gas and are available from refinery gases in which ethylene occurs along with other low-boiling components. It's difficult to break down the actual proportion of each source used, so the charts above must be considered rough estimates. However, refinery gases are expected to be the more widely used source in the future.

▶**Many C_2 Derivatives**–Ethyl alcohol accounts for approximately one-third of the total output of

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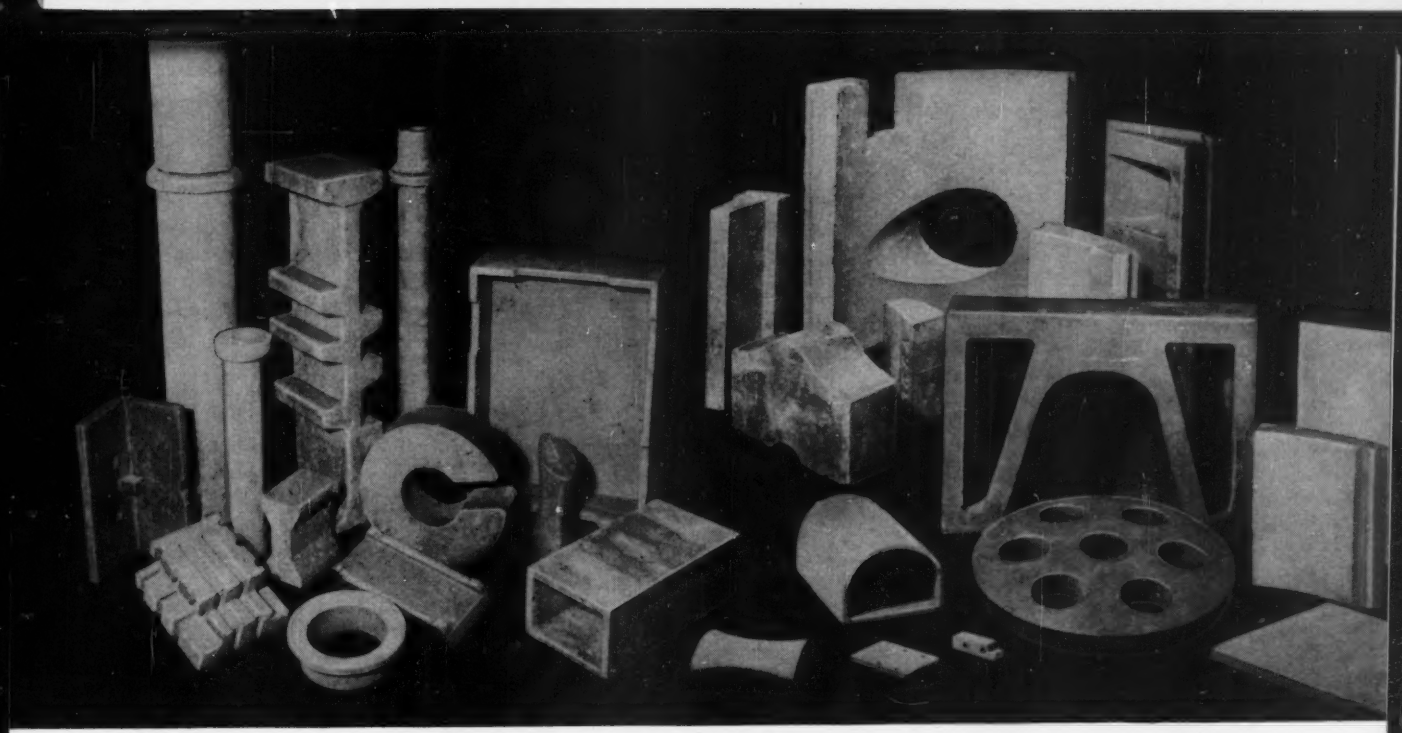
To give you a comprehensive round-up on individual petrochemicals, we have split this report into three parts. This month we review ethane, ethylene and their derivatives. Watch for propane, butane, their derivatives, and higher hydrocarbons in November. In September we covered the general health of the industry and detailed developments in methane and its derivatives.



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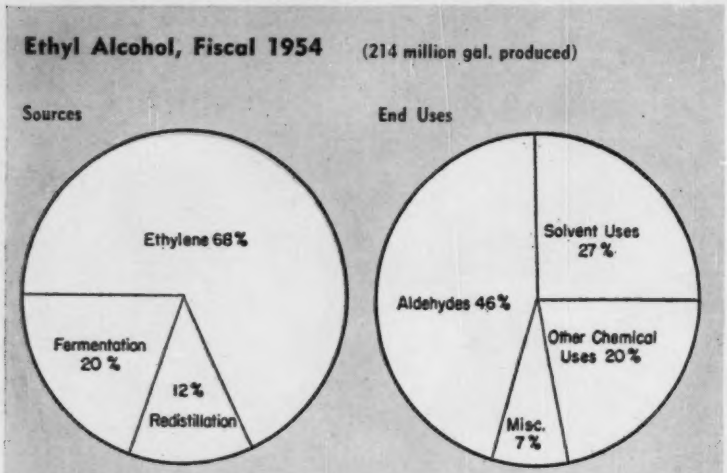

U. S. Industrial Ethyl Alcohol Capacities

Producer	Location	1955 (Million Wine Gal./Yr.)	Projected Increase
Synthetic			
Carbide and Carbon	South Charleston, W. Va. / Whiting, Ind. / Texas City, Tex.	90	0
Dupont	Belle, W. Va.	2	0
Esso Standard Oil	Baton Rouge, La.	40	0
National Petrochemicals	Tuscola, Ill.	40	0
Shell Chemical	Houston, Tex.	17	?
Stanolind Oil & Gas	Brownsville Tex.	0	6.5
Texas Eastman	Longview, Tex.	12	0
Total		201	6.5+
Fermentation		250	0
Total		451	6.5+

ethylene, followed in turn by ethylene oxide, styrene, polyethylene and ethyl chloride. Demand for ethylene is expected to continue to grow, particularly as the markets for new derivatives expand. Most notable will be the increased use of polyethylene plastics.

Most ethylene is produced for captive requirements. However, Gulf Oil Co. at Port Arthur, has just completed a mammoth new unit and can now produce about 400 million lb. a year of ethylene for sale. Before expansion, Gulf's annual output was about 180 million lb./yr.

It's interesting to point out that there is a small captive production of ethylene from ethyl alcohol by Westvaco Mineral Products Div. This is consumed in the manufacture of ethylene dibromide.

► **Alcohol and Aldehyde**—The most important chemical made from ethylene is ethyl alcohol. As shown on the above chart, production of ethyl alcohol in fiscal 1954 was 214 million gal. Of this, about 68% came from ethylene, the rest from fermentation and redistillation.

Approximately two-thirds of all ethyl alcohol goes into chemical manufacture, particularly the production of acetaldehyde. The table shown above lists the production capacities of the various producers of synthetic industrial ethanol in 1955, with projected increases.

Acetaldehyde, the principal outlet for ethanol, has been in oversupply. Requirements for the aldehyde—because of its derivatives, acetic acid and acetic anhydride—are dependent largely on the acetate rayon industry. With the depressed condition of textiles in most of 1954, acetyl radical consumed directly in rayon manufacture decreased from about 600 million lb. in 1953 to less than 500 million lb. last year.

► **Two Oxide Routes**—There are two methods used for converting ethylene to ethylene oxide. The first involves the use of chlorine; the second is direct oxidation.

Carbide and Carbon Chemicals Co. is by far the biggest maker of ethylene oxide and has plants using both production methods. (However, its most recently installed production unit is based on the oxidation route.)

As shown in the table on page 284, Carbide's total capacity in six plants will be approximately 600 million lb. of oxide and 472 million lb. of ethylene glycol per year. Carbide will account for nearly two-thirds of the total U. S. oxide capacity, though only about one-half of the glycol output. This results from the fact that Carbide has been very active in converting ethylene oxide to other products besides the glycol.

► **Glycol Still Falling**—The production of ethylene glycol during 1954 was about 600 million lb. However, note that production figures include the output of Du Pont which uses a process involving formaldehyde and carbon monoxide rather than ethylene oxide. (This accounts for just over 15% of the total ethylene glycol produced in this country.)

During the past three or four years there has been a steady decline in the output of glycol because of the depressed market for permanent-type antifreeze. With the heavy 1955 sales of new automobiles, which tend to favor permanent-type antifreeze, we project that ethylene glycol sales will improve. Traditionally, the sale of methanol antifreeze increases as the average age of automobiles increases.

The use of the new fibers Dacron and Mylar will also require additional quantities of ethylene glycol. But these markets will be small compared with antifreeze.

► **Styrene Ranks Third**—Styrene

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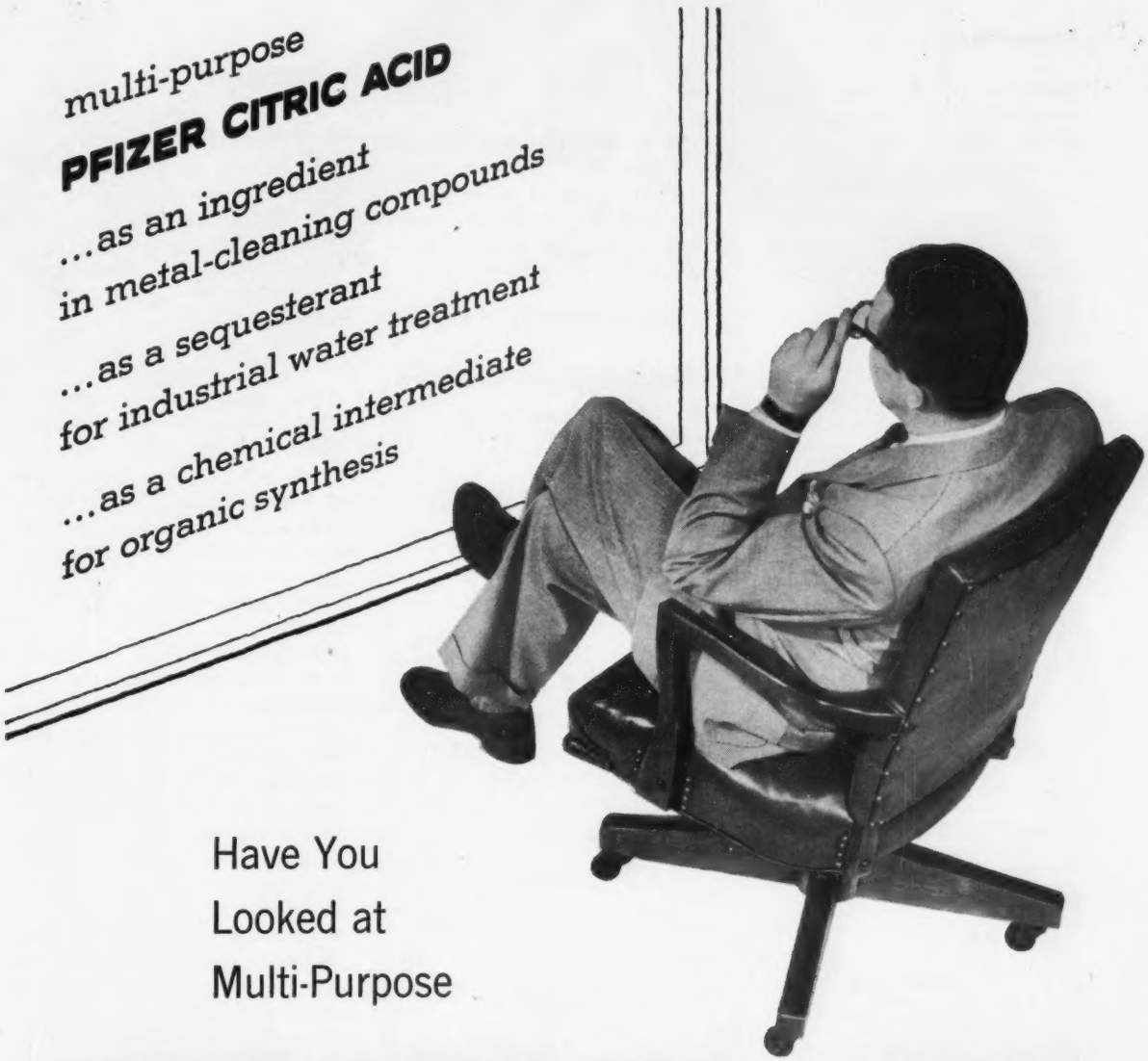
...as a chemical intermediate for organic synthesis



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Since it forms water soluble complexes with metallic ions such as iron and calcium, Pfizer Citric Acid makes an ideal sequestering agent to keep metals from precipitating out of solution. As a sequesterant, it is used in industrial water treatment, edible oil production, 2, 4-D formulations and manufacturing processes.

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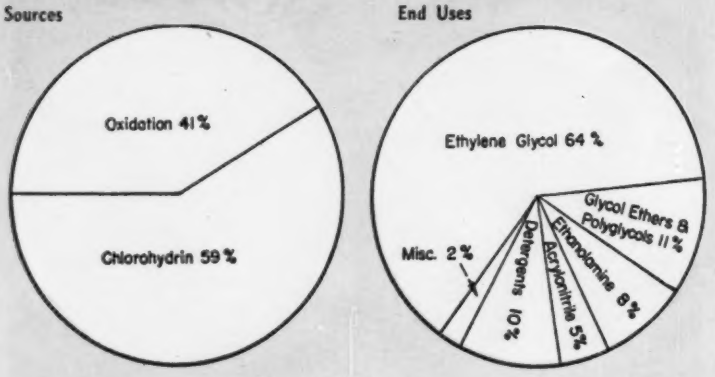
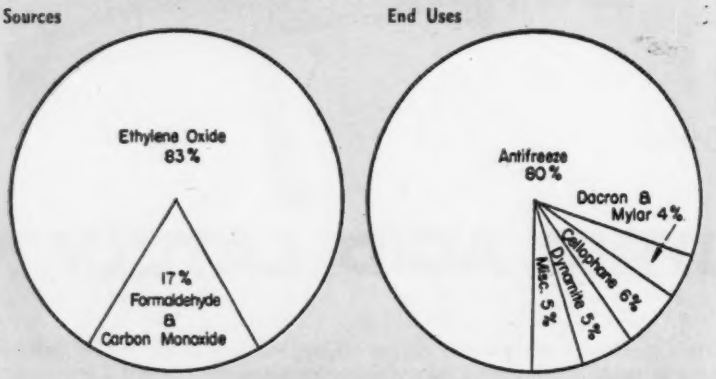
production is the third biggest use for ethylene. A substantial part of the country's styrene capacity was created during World War II to fill the needs of the synthetic rubber program. But with the recent acquisition of the Torrance, Calif., plant by Shell Chemical, all these plants are now privately owned (see *table page* 286).

Most recent entrant in the field is Foster Grant with a 24-million-lb./yr. plant at Baton Rouge. The firm also recently announced plans to raise this capacity to 50 million lb.

Ethylene Oxide, 1954 (580 million lb. produced)



Mono-Ethylene Glycol, 1954 (600 million lb. produced)



U. S. Ethylene Oxide and Ethylene Glycol Capacities

Producer	Plant Location	Ethylene Oxide (Million Lb./Yr.)	Ethylene Glycol (Million Lb./Yr.)
Allied Chemical	Orange, Tex.	35	35
Carbide & Carbon	South Charleston, W. Va.	550[1]	470
	Institute, W. Va.		
	Whiting, Ind.		
	Texas City, Tex.		
	Seadrift, Tex.		
	Torrance, Calif.		
Dow Chemical	Midland, Mich.	150	130
	Freeport, Tex.		
Du Pont	Belle, W. Va.	...	130
Jefferson Chemical	Port Neches, Tex.	90	75
Olin Mathieson	Brandenburg, Ky.	75	95
Wyandotte Chemicals	Wyandotte, Mich.	30	35
Total		930	970

[1] Being expanded by 50 million lb.

GR-S rubber has been the principal outlet for styrene. This outlet has good growth potential despite the increasing use of oil extenders which cut down the required proportion of styrene. Further, polystyrene is a growing market and the use of the styrene-butadiene copolymers will increase, notably in paints.

Other major uses for ethylene in order of importance are polyethylene, ethyl chloride, ethylene dichloride and ethylene dibromide. Ethyl chloride manufacture is closely related to the manufacture of tetraethyl lead where it serves as an important intermediate. Principal manufacturers of ethyl chloride are Ethyl Corp., Du Pont, National Petrochemicals, Shell and Dow.

Ethylene dibromide, a relatively small outlet for ethylene, is used mostly in tetraethyl lead where it acts as a scavenger to remove lead from gasoline engines. Ethyl-Dow in Texas is by far the biggest producer of the dibromide, with Westvaco at Newark, Calif., and American Potash at Vernon, Calif., accounting for most of the remaining production.

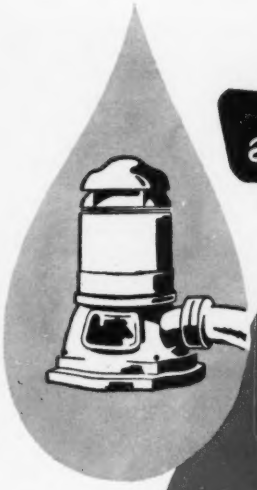
▶ **Vinyl Chloride Active**—Ethylene dichloride is also of interest in the manufacture of tetraethyl lead fluid where it is used to the extent of about 18% and serves as a preservative.

However, a more important outlet for ethylene dichloride is in the manufacture of vinyl chloride monomer. About 45% of total vinyl chloride production is now based on ethylene and chlorine with the remaining 55% coming from acetylene and hydrochloric acid.

Total production of vinyl chloride monomer was nearly 400 million lb. in 1954. It went mostly into polyvinyl chloride and other polymers, while some was used to make synthetic fibers and Saran films.

▶ **Polyethylene Pushing**—The most interesting and perhaps the most rapidly growing outlet for ethylene is in the manufacture of polyethylene. Total capacity for polyethylene by the end of 1954 was nearly 400 million lb./yr.

ask the man from Layne



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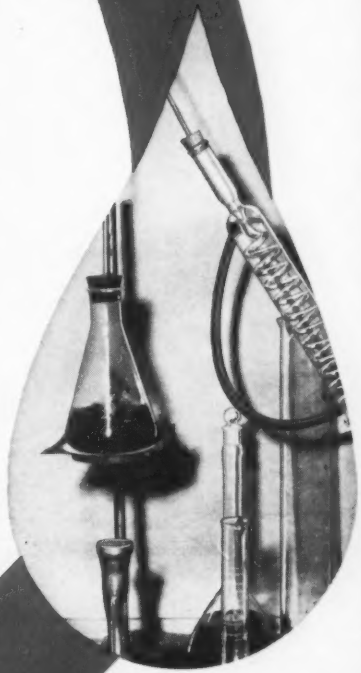

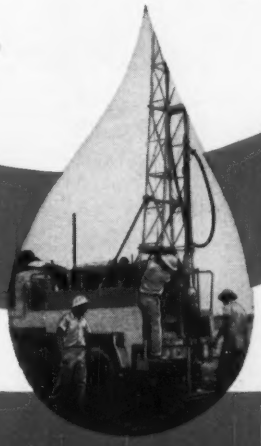

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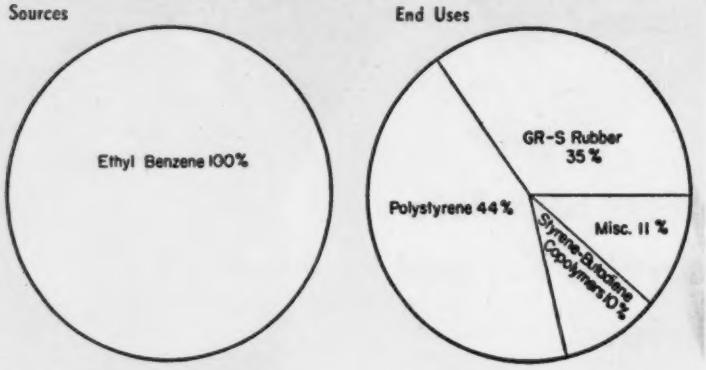
Styrene Monomer, 1954 (703 million lb. produced)

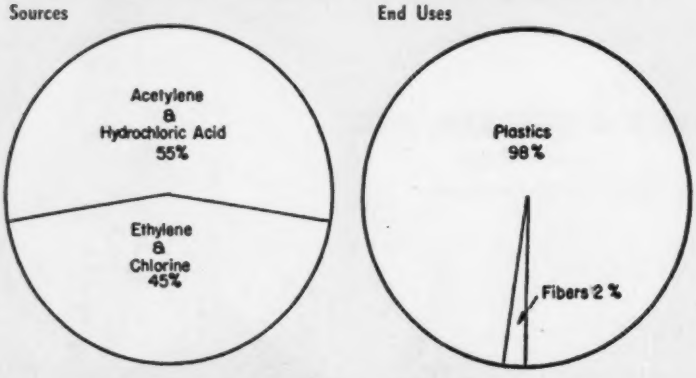


U. S. Styrene Capacities

Producer	Plant Location	1955 (Million Lb./Yr.)	Projected Increase
American Cyanamid	Fortier, La.	0	40[1]
Carbide & Carbon	Institute, W. Va.	65	0
Dow Chemical	Freeport, Tex.	285	0
	Midland, Mich.	200[2]	0
Foster Grant	Baton Rouge, La.	25	25
Koppers	Kobuta, Pa.	160	0
Monsanto Chemical	Texas City, Tex.	240	0
Shell Chemical	Torrance, Calif.	135	0
Total		1,110	65

[1] Methyl styrene, now under construction.
[2] Includes 80 million lb. vinyl toluene.

Vinyl Chloride Monomer, 1954 (385 million lb. produced)



U. S. Vinyl Chloride Monomer Capacities

Producer	Location	1955 (Million Lb./Yr.)	Projected Increase
Carbide and Carbon	South Charleston, W. Va.	150	0
	Texas City, Tex.	30	0
Diamond Alkali	Houston, Tex.		
Dow Chemical	Midland, Mich.	75	0
	Freeport, Tex.		
Escambia Bay Chemical	Pensacola, Fla.	0	25
General Tire & Rubber	Ashtabula, Ohio	25	0
B. F. Goodrich Chemical	Niagara Falls, N. Y.	115	50
	Louisville, Ky.		
	Calvert City, Ky.		
Goodyear Tire & Rubber	Niagara Falls, N. Y.	35	0
Monsanto Chemical	Texas City, Tex.	60	0
U. S. Rubber	Painesville, Ohio	50	0
Other		0	50
Total		540	125

Another 120 million lb. is projected for 1955 with Carbide and Carbon Chemicals expecting to complete its 60 million lb./yr. plant in Torrance, Calif., either by the end of 1955 or early in 1956.

As has been pointed out by other writers, polyethylene is an excellent example of the spectacular petrochemicals that have attracted a number of companies with little or no previous experience in the complex synthetic organic industry.

While the prospects for polyethylene are very encouraging, it is generally recognized that the capacity in place by the end of this year will far exceed demand for the next several years. This, of course, will tend to reduce the price which may encourage use of polyethylene in new products.

Industry's Moving, So Are Chemicals

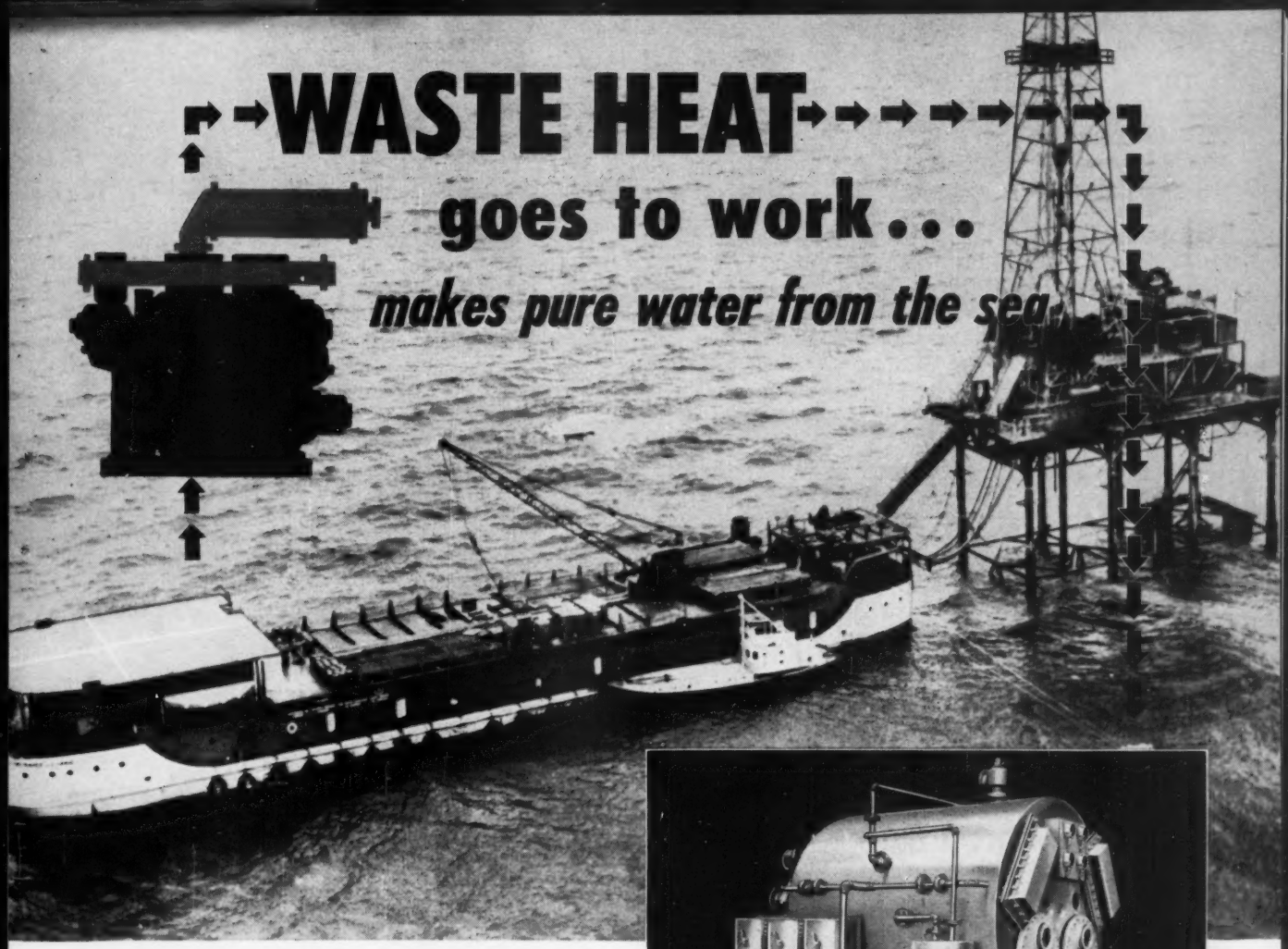
Two important facts stand out in a new survey of industrial migration just completed by the McGraw-Hill Economics Dept.:

- Industry continues to move from the manufacturing cores of the East and Midwest to the booming centers of the South and West.
- The rate of migration hasn't slacked from the days of dispersion during World War II.

Here's how industry's face has changed since 1947 in terms of manufacturing employment:

Region	% of U. S. Total 1947	1954	% Change
New England	10.03	9.04	−9.9
Middle Atlantic	29.51	28.04	−5.0
South Atlantic	8.87	9.15	+3.1
Great Lakes	29.61	28.66	−3.2
Farm West	5.55	6.03	+8.7
South Central	4.64	4.68	+0.9
Southwest	4.07	4.75	+16.7
Mountain	0.97	1.09	+1.2
Pacific	6.75	8.56	+26.8

The chemical industry showed one major shift: The Middle Atlantic's share has been cut substantially—nearly 15%—from 36.4% of U. S. chemical employment in 1947 to 31% in 1954. All other regions except New England benefitted, particularly the Southwest—up from 6.5% of the total to 8.5%.

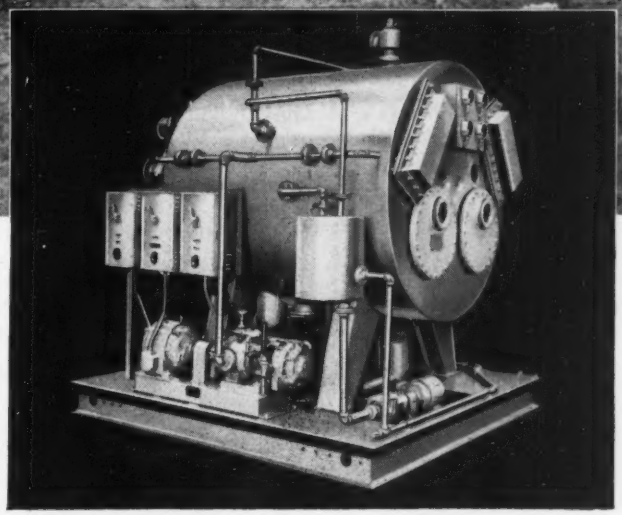


CATC and Cleaver-Brooks join to make history with potable water at zero cost

Diesel engine cooling water need no longer be wasted. It can go to work as a *valuable tool, producing low-cost pure water!* This was demonstrated recently with the launching and christening of the CATC's off-shore drilling tender, *Jack Cleverley* at the Levingston Shipbuilding Company, Orange, Texas.

This installation represents *the most modern Waste Heat Evaporator in this area of operations.* It is the ultimate in design for this type of service.

Cleaver-Brooks Company is proud to have been part of this event. We salute the CATC Group, including Continental Oil Company, Atlantic Refining Company, Tide Water Associated Oil Company, Cities Service Company and the Levingston Shipbuilding Company.



Cleaver-Brooks Waste Heat Evaporators are particularly adaptable to off-shore drilling platforms, tenders and diesel barges

Practically no scale removal. Potable water is produced from the sea at zero cost because unit uses waste heat from rig's diesel engines . . . transmitting it through heat exchangers charged with sea water. Hot water flashed into a vacuum chamber is partially converted into steam, which is then condensed on cooling coils for the output of distilled water for "mud" make-up, drinking, etc. Unit above has a capacity of 300 gph — similar units can be built to match actual water needs.

For complete details on Waste, Heat, Flash Type, Vapor Compression and Low-Pressure Steam Evaporators — for any pure water need — write: CLEAVER-BROOKS COMPANY, Dept. L. Special Products Division, 365 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CLEBRO-Milwaukee — all codes.

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ECONOMICS . . .

Pulp and paper held closely to the over-all industry trend. The Northeast, which had 43.9% of this employment in 1947, had only 40.2% last year. Most of this loss was picked up by the South and West. The Great Lakes' share dropped from 28.5% to 27.3%.

Petroleum and coal products continued to move south, but slowly. In 1954 the Southwest accounted for 29.6% of U. S. jobs in this industry—up from 28.3%. The Middle Atlantic's share dropped from 28.0% to 26.5%.

Rubber products, with 50% of its 1947 employment centered in the Great Lakes region (more than one-third in Ohio alone) has shifted only slightly. The Great Lakes' share in 1954 was 47.1% and what little migration there was mostly to the Pacific and the Farm West.

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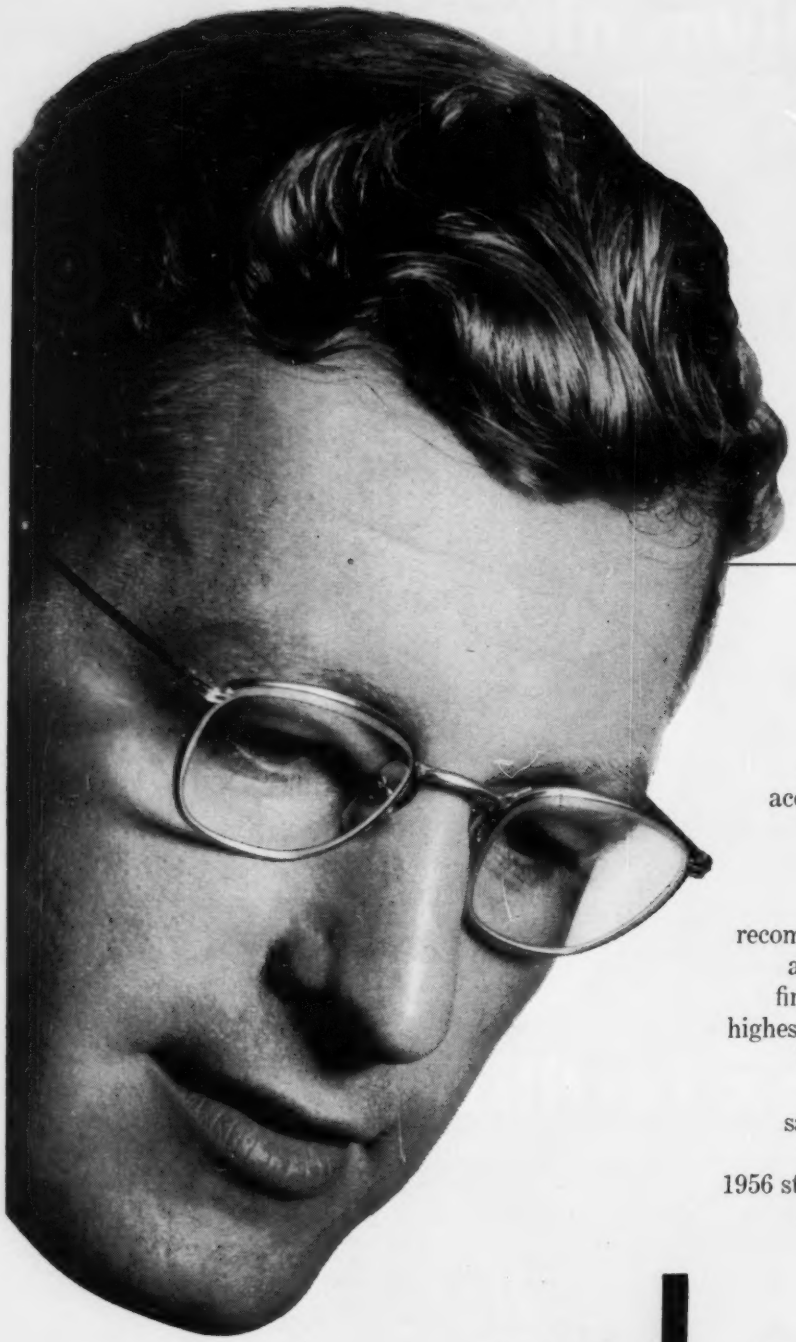

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NEWLY DESIGNED AND ENGINEERED "from the ground up" . . . with greater protection than ever . . . greater field of vision than ever . . . more wearer acceptability than ever . . . with many new features — these are the most advanced of safety glasses.

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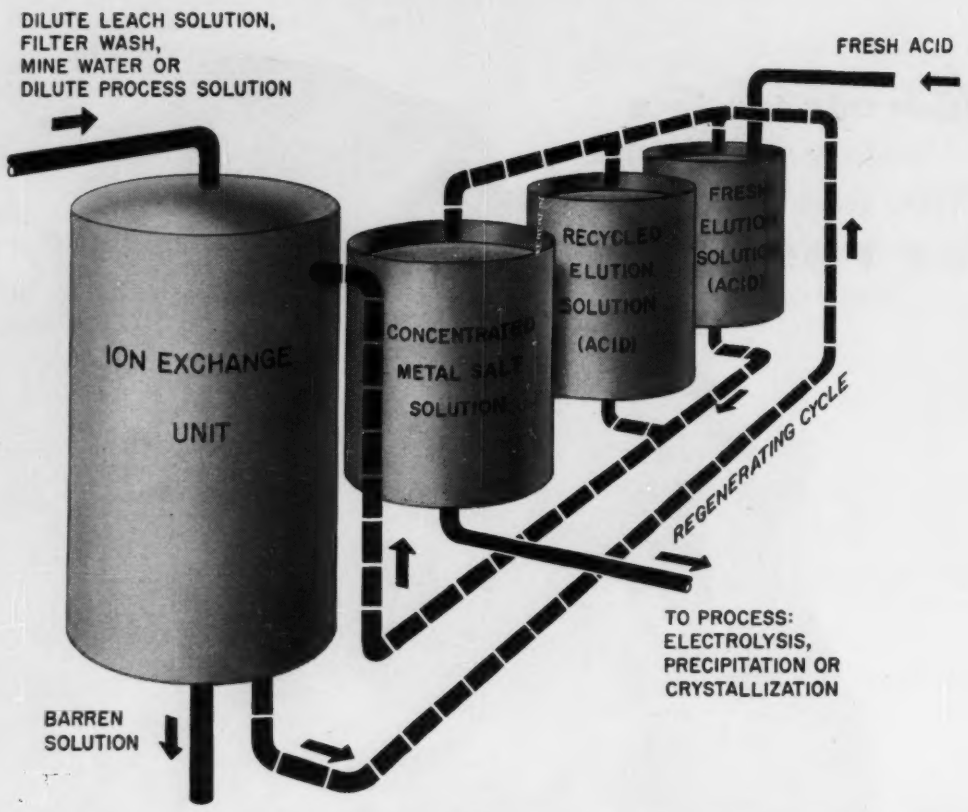
METAL CONCENTRATION BY ION EXCHANGE



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Ion Exchange gives Better Yields

• Ion exchange increases yields, simplifies flow sheets and cuts labor, supervision and chemical costs when used with other hydrometallurgical processes such as Leaching, Clarification, Filtration, Purification, Precipitation and Electrolysis.

The simplified flow diagram shown above illustrates the main principles of ion exchange in concentrating metals from leach liquors, filter washes, other dilute process solutions or mine waters:

As the feed solution or mine water passes through the ion exchange unit, the metal values are concentrated on the ion exchange resin, generally in preference to other ions present, leaving the solution or mine water metal-free. When the metal-attracting property of the resin is exhausted, an appropriate elution solution, for example an acid, is passed through the resin to pick up the metal. In most cases, the elution solution also acts as regenerant to restore the metal-attracting capacity of the resin . . . as shown on the diagram. Recycling the elution solution provides high concentrations . . . often several thousand times as concentrated as the original feed solution.

Ion Exchange methods apply to these metals:

Base Metals	Minor Metals	Precious Metals
Copper	Cobalt	Gold
Zinc	Tungsten	Silver
Lead	Molybdenum	Platinum
Tin	Vanadium	**Rare Earths**
Aluminum	**Decorative Metals**	Lanthanide Group
	Nickel	Actinide Group
	Chromium	Uranium

The Permutit Company not only designs and builds complete ion exchange systems, but also manufactures ion exchange resins and zeolites for all industrial applications. For information, write: The Permutit Company, Dept.CE-10, 330 West 42nd St., New York 36, N. Y.

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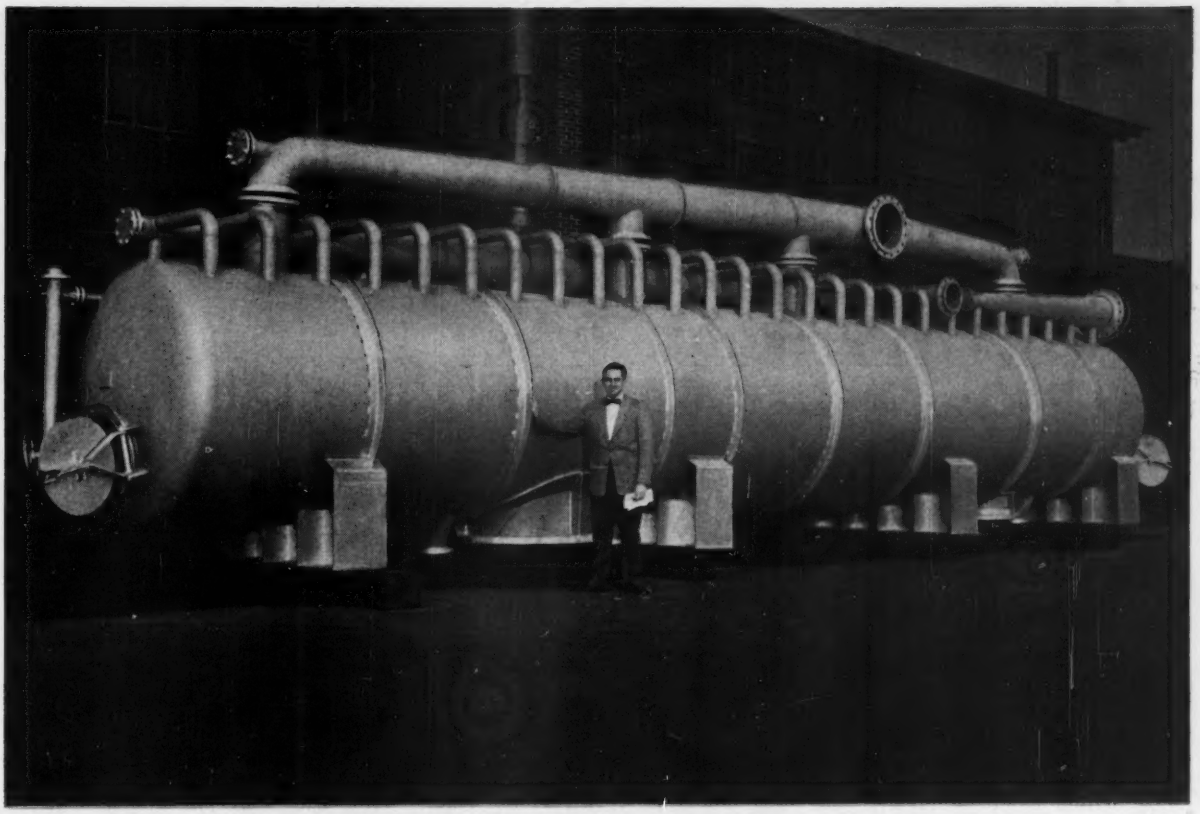

Receiver of type 304 Crucible Rezistal® stainless steel fabricated by O. G. Kelley and Company for the Rotareaed Corporation.

why it cost less to use stainless

This vessel improves the quality of paper stock. It is the receiver unit in the "Deculator" process, which removes all gasses from the wet stock in paper-making operations.

These receivers used to be made of carbon steel, lined with a phenolic resin. But the designers, The Rotareaed Corporation, wanted a material that could better withstand the highly corrosive nature of some paper stocks and the erosion that normally takes place within the receiver.

Then Crucible stainless steel, type 304, was tried. In the long run it proved to be less expensive. For stainless *fights* corrosion. Because it is almost impervious to oxidizing acids, it resists attack by corrosive paper stocks.

What's more, the erosion that used to be so costly in previous receivers has an insignificant effect on stainless. With its tough, abrasion-resisting surface, stainless often outlasts other metals scores of times in erosive or abrasive environments.

As a leading stainless steel producer, Crucible has much application and fabrication data to offer you. You'll find a great deal of this type of information in "Making the most of Stainless Steels in the Chemical Processing Industry." Write for your free copy. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

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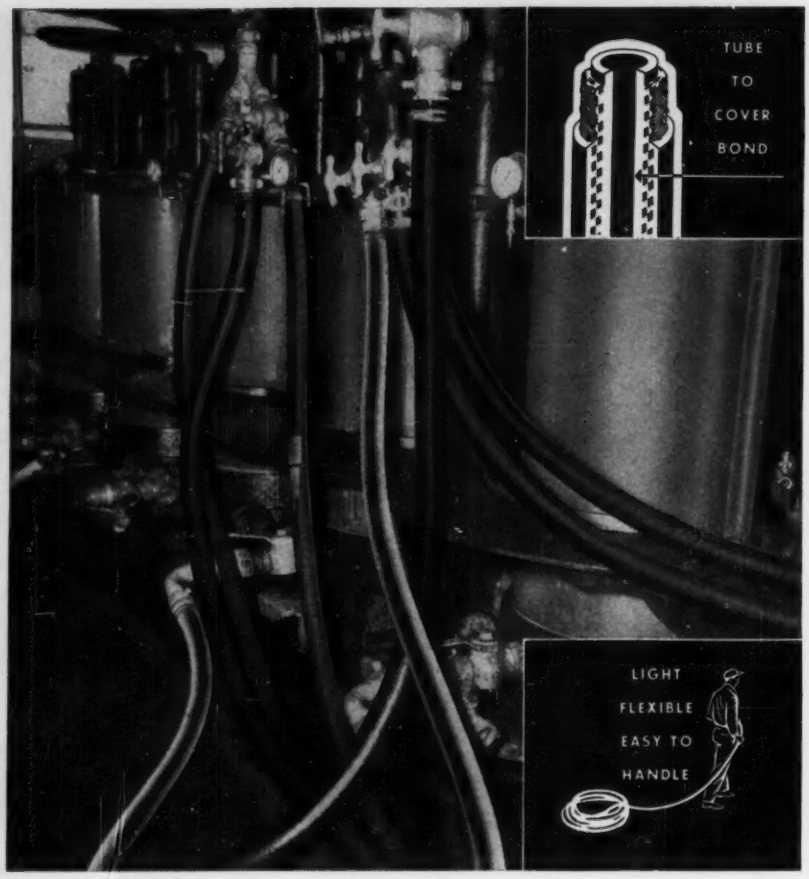
Hose that is light in weight—yet strong enough to safely withstand high pressures—is easier to handle. Men like it better and do more work with it. Look for a hose that is light, yet strong, for ease of handling.

If the hose you buy resists kinking you are assured maximum flow under all operating conditions. Hose that is mandrel-made, rather than molded in a pre-set coil, will coil and uncoil freely in any direction . . . eliminate points of strain at kinking points that can cause costly internal damage and rupture.

Make certain the hose is engineered for maximum flexibility . . . from tube to cover. Tube-to-cover flexibility prevents separation of cover, tube or strength member plies . . . reduces hose costs by increasing hose life.

Specify the one hose that gives you all these features . . . specify R/M Homoflex Hose.



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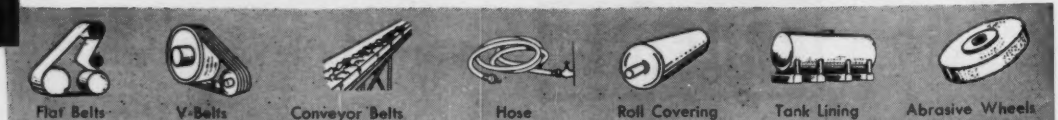

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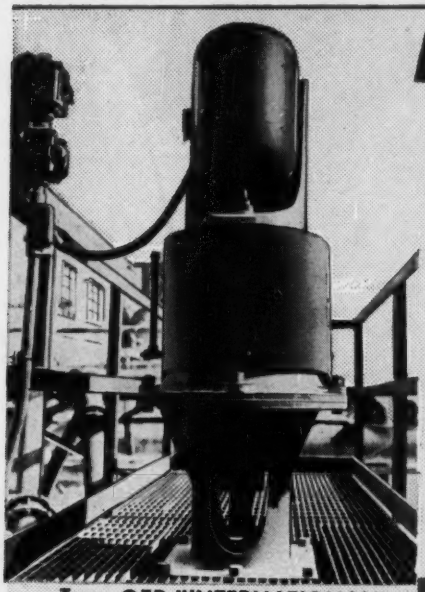

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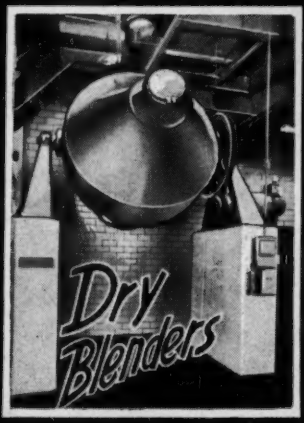

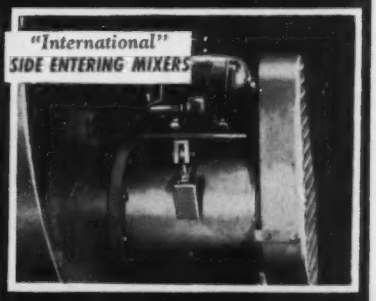

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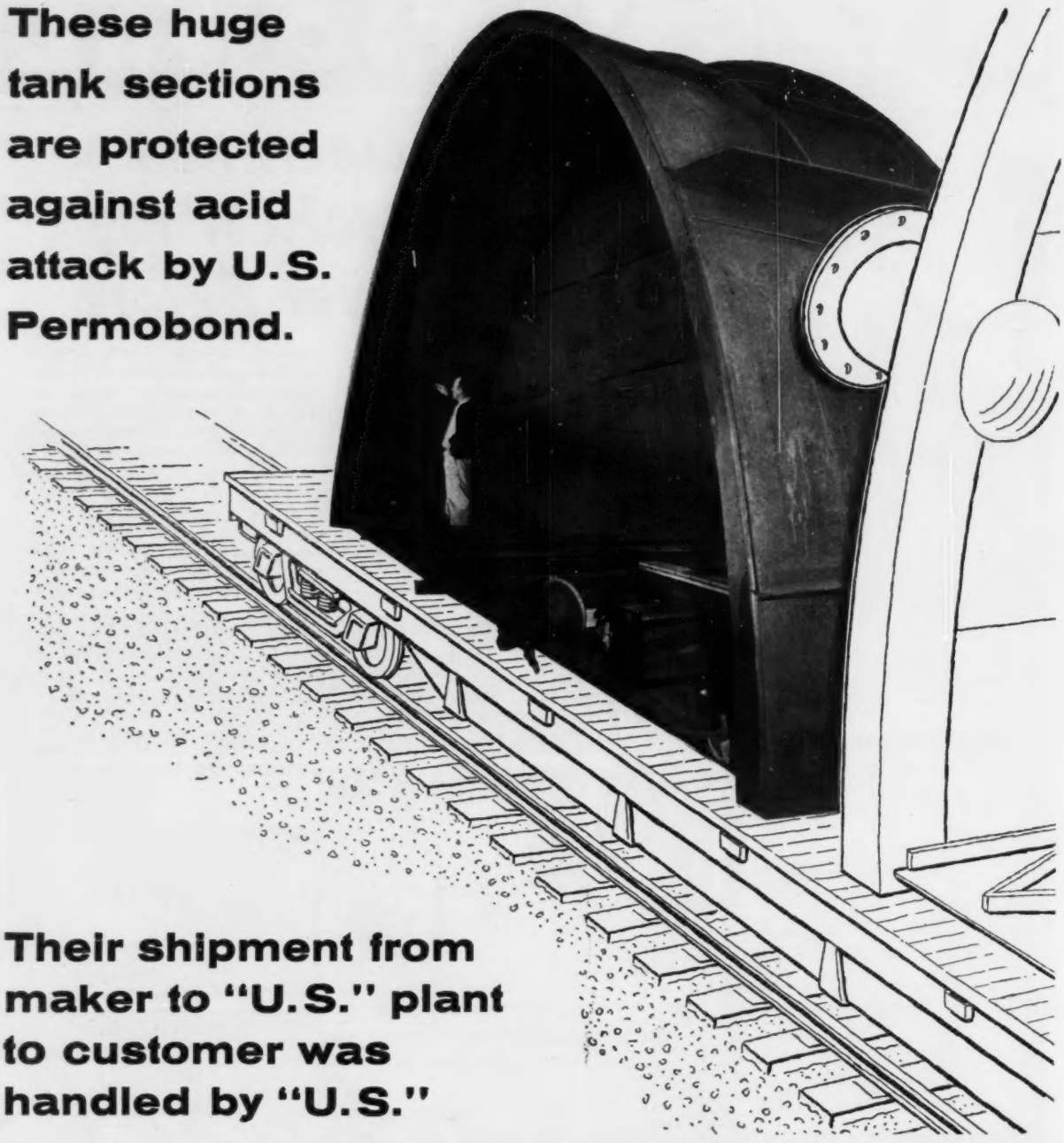
These huge tank sections are protected against acid attack by U.S. Permobond.



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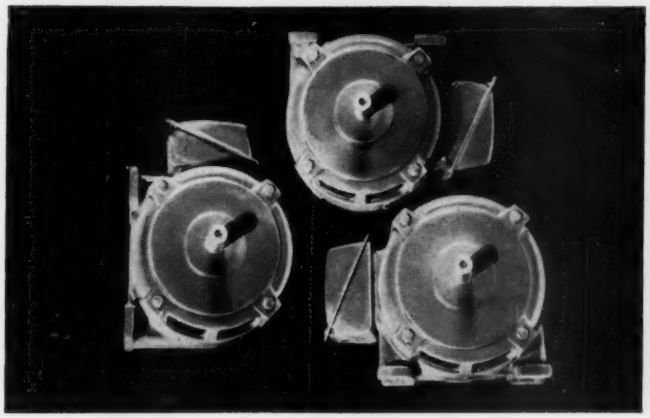
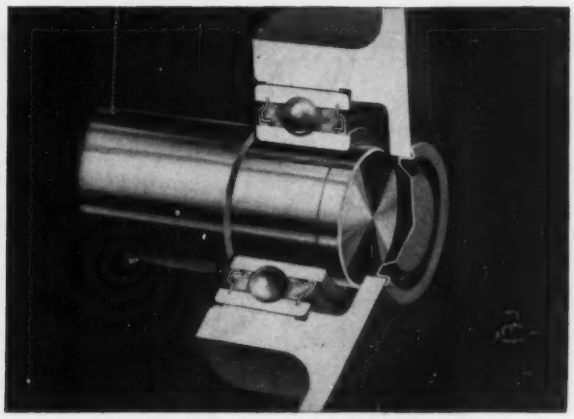
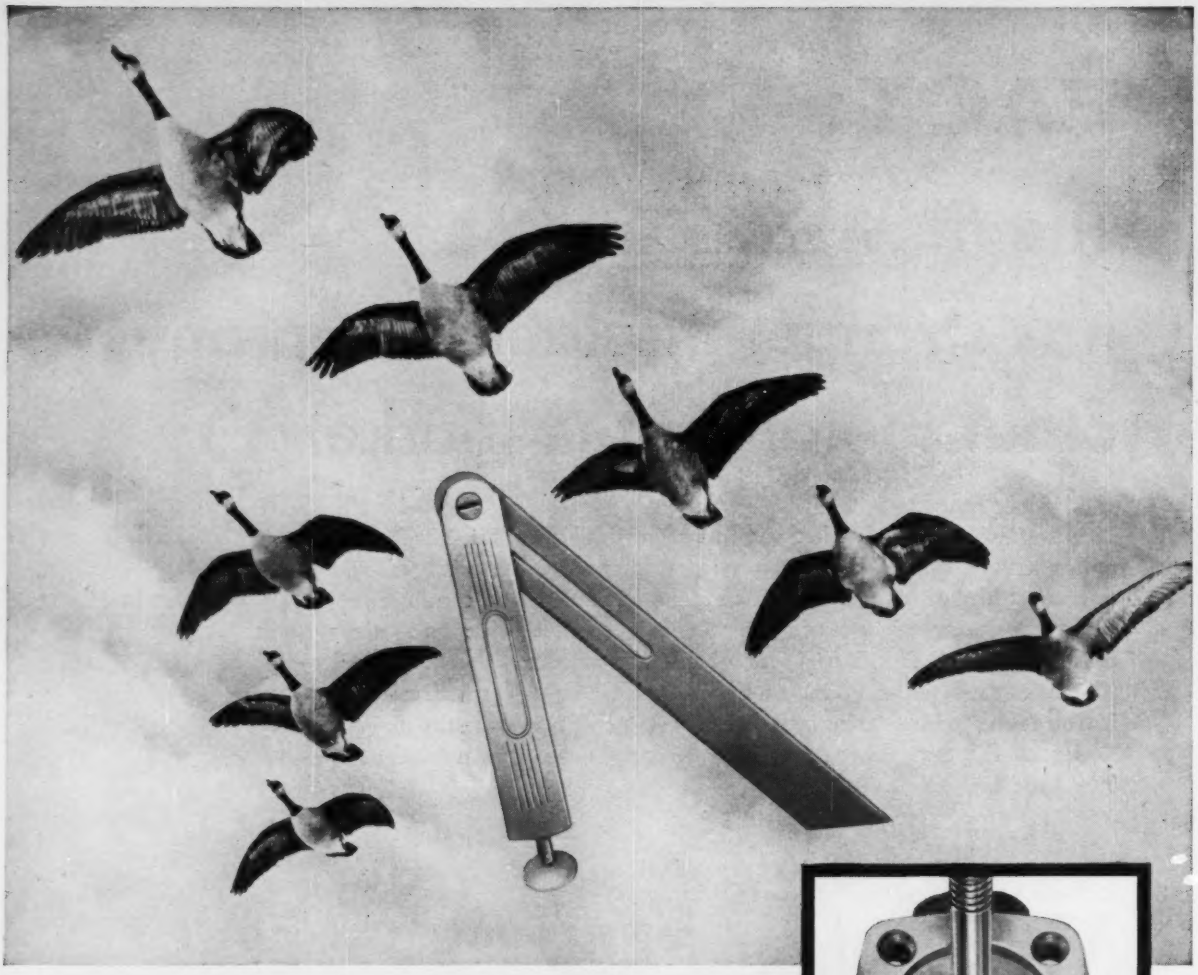
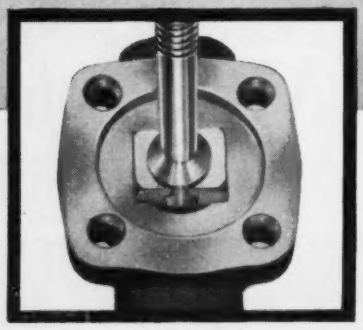


Mechanical System Fact: New cast-iron housing on both drip-proof and totally-enclosed types. Ventilation openings only in end brackets make the motor drip-proof whether mounted on floor, ceiling or wall.

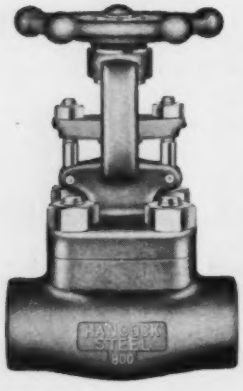


Lubrication System Fact: New "4-way sealed", pre-lubricated bearing eliminates completely the 3 main causes of bearing failure: 1) contamination, 2) over greasing, 3) wrong grease.





GUIDE-ABILITY
that means longer life



FULL GUIDING in the Type 950 Hancock Steel Gate Valve does not permit the wedge to gall, scuff, chip or wear the seating surfaces. Four accurately-machined grooves in the valve body guide the wedge to and from the seats and prevent wedge rotation. No matter how great the flow and pressure load or the rotating force exerted by turning the handwheel, the wedge corners do not hit or rub across the seating surfaces. This close-clearance guiding protects against seat damage that frequently causes other valves to leak in as few as one opening-and-closing operation at service pressures.

The provision for precise *full guiding* adheres to the principle that valve seats and wedges *should wear from long service, not from battering against each other.* It is one of many quality features that keep Type 950 Hancock Steel Gate Valves in the line longer. Your Industrial Supply Distributor will gladly demonstrate. Phone him today.

HANCOCK VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Watertown 72, Massachusetts

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

WHICH *Figure Type*
IS YOUR FORMED PRODUCT?

with SIMPSON MULLING *all* shapes are fashionable

The formed products shown above are about as unalike in use and method of forming as are the Paris fashions from one generation to the next—but like ladies' apparel, they have one thing in common... they must be designed and produced to *fit*.

Whether they're extruded, pelletized, briquetted or cast, formed products must be thoroughly, *intimately* mixed to insure uniform dispersion of moisture and binder. Lack of proper dispersion means poor green strength or resistance to deformation and breakage... rejects, if discovered prior to firing and *trouble* in the form of porosity, poor finish and shrinkage, if discovered after firing.

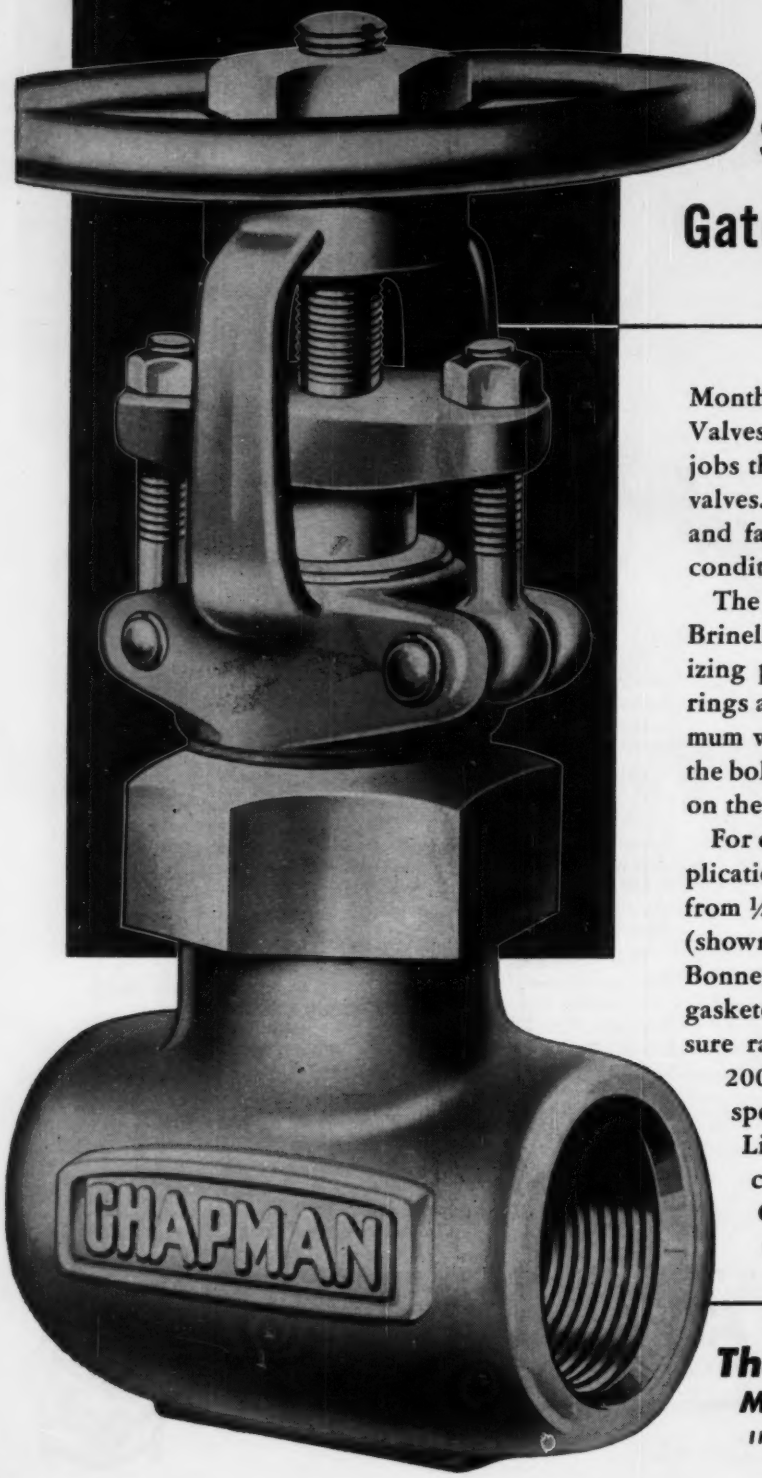
The photos have another thing in common—they're all selected from an *impressive* collection of tough jobs solved through controlled mulling in a Simpson Mix-Muller. If *you* mix... and it's dry but not a powder, wet... but not a fluid, it will pay you to find out why Simpson mulling is more economical, certainly more efficient than any ordinary mixing method you may now employ.

Available in 12 models in batch capacities of from 1/10 to 60 cu. ft., Simpson Mix-Mullers are serving every phase of the Chemical and Process Industry. Write for details and remember... mixing is our business, our principal business since 1914.

A new 12 page bulletin providing complete specifications, capacity requirements and industries served by Simpson Mix-Mullers is available on request.

SIMPSON *MIX-MULLER*® DIVISION
NATIONAL ENGINEERING CO., 636 Machinery Hall Bldg., Chicago 6, Ill.
(Not Inc.)

Chapman List 960



...for EVERY Small Forged Steel Gate Valve Application

Month after month, Chapman List 960 Valves deliver the goods on more different jobs than any other small forged steel gate valves. And maintenance charges are few and far between even under the toughest conditions.

The wedge gate faces — hardened to 800 Brinell by Chapman's exclusive Malcomizing process — won't seize or gall. Seat rings are hardened stainless steel, for minimum wear, and are easy to replace. Also, the bolted follower has no exposed threads on the yoke to corrode.

For every small forged steel gate valve application, specify Chapman List 960. Sizes from ¼" to 2", either rising stem with yoke (shown) or rising stem with inside screw. Bonnet joint is ground metal-to-metal or gasketed, depending on application. Pressure range is from 380 psi at 1000°F to 2000 psi at 100°F. For higher ratings, specify List 990.

List 960 is made in various alloys and combinations of alloys as listed in Catalog No. 10. Write for your copy today.

The CHAPMAN Valve
Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

Rubber Epicure?

—here's a recipe that will delight you!

SLAB SOLE COMPOUND

	Parts by Weight
GR-S, 1006	90
High Styrene Resin	10
NEVILLE LX-685, 135	12
Antioxidant	1
Calcium Silicate	50
Hard Clay	200
Zinc Oxide	5
Process Oil	5
Mold Lubricant	2.5
Stearic Acid	1.5
Benzothiazyl Disulfide	1.5
Zinc Dimethyl Dithiocarbamate	0.5
Rubbermakers Sulfur	4
Total	**383.0**

For extremely high hardness, approximately 5 parts of phenolic resin may be added.

Cure: 6 minutes at 310°F.
Specific Gravity: 1.66
Hardness, Shore A: 96
Color: Light Brown
Mold Release: Good
Hot Tear Resistance: Good
Cost per pound (estimated): $.092

To Satisfy Your Epicurean Taste for

EASE OF PROCESSING
HIGH HARDNESS
ABRASION RESISTANCE

at low cost specify
NEVILLE LX-685,135

NEVILLE CHEMICAL CO.
PITTSBURGH 25, PA.
Plants at Neville Island, Pa., and Anaheim, Cal.

R-56

NEVILLE

It's in the Bag!

Fresh, Clean Ink for a Year of Trouble-free Recording

★ You won't have any messy, time-consuming re-inking of pens on the new Bailey Recorders. The entire system is white-glove clean—hermetically sealed, non-evaporating, non-corrosive. Gone is any chance of sludge or oxide formation. Gone are clogged pens, interrupted records, unsightly splashes.

The transparent plastic ink sacs are changed once a year—that's all. Capillary tubing carries fresh, clean ink to the pens continuously without any day-to-day attention.

This exclusive new inking system* is only one of the many time-saving, money-saving distinctive features of the new Bailey Recorder.

Ask for Product Specification E12-5. P34-1

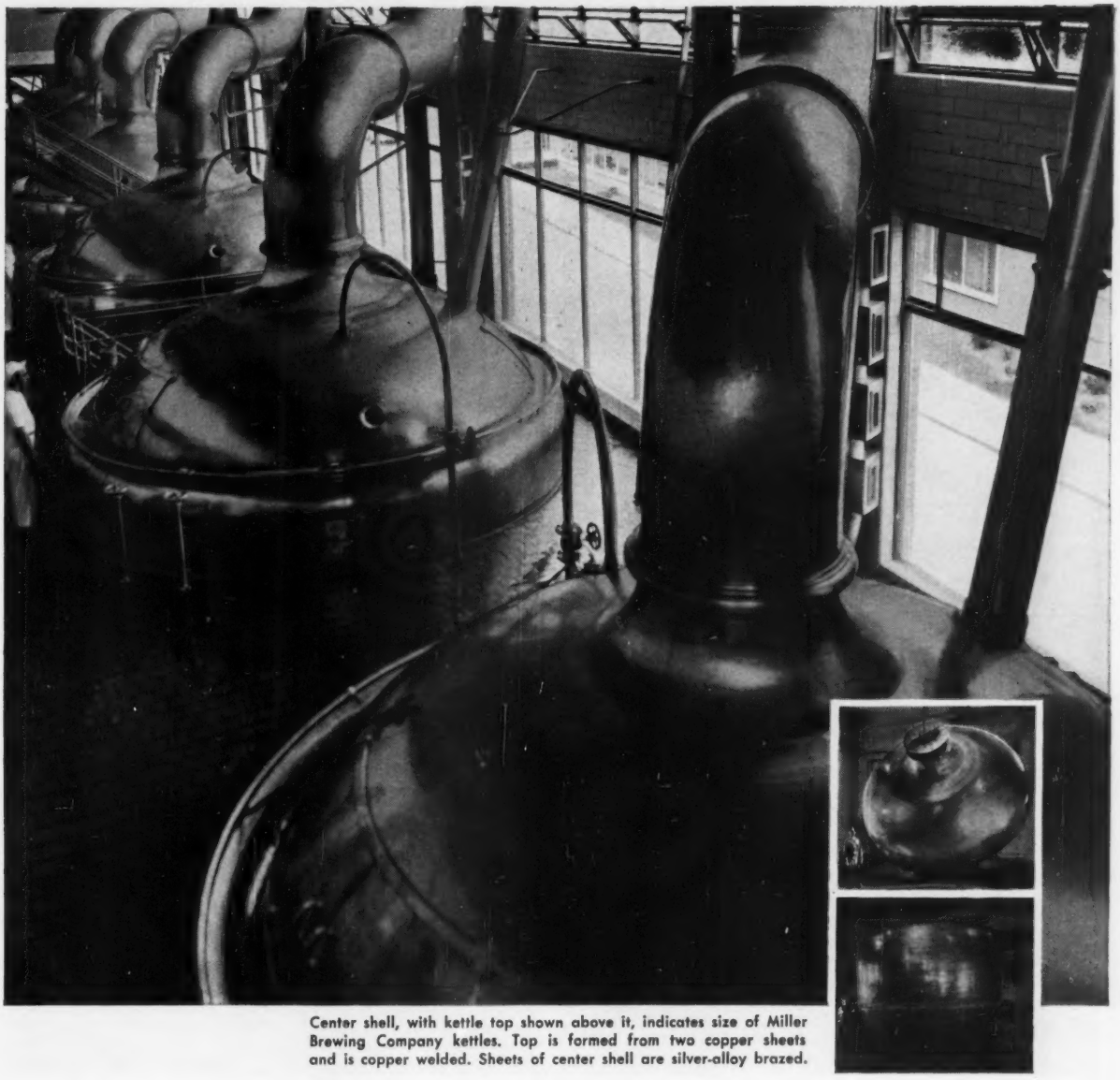
*Now available for the New Bailey ... recorder only.

ONLY BAILEY OFFERS ALL THESE ADVANTAGES IN A SINGLE RECORDER

- Pre-calibrated plug-in receiver units
- Up to four pneumatic or electronic receivers —or two receivers and two integrators
- Any four variables on one chart—easily read and interpreted
- A full year's ink supply at one loading
- Faster ordering—from stock
- Minimum inventory of parts
- Minimum instrument investment for process cycle expansion or alteration

BAILEY
METER COMPANY
1054 IVANHOE ROAD
CLEVELAND 10, OHIO
Controls for Power and Process

BAILEY METERS
Controls for
TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW · LEVEL
RATIO · DENSITY



Center shell, with kettle top shown above it, indicates size of Miller Brewing Company kettles. Top is formed from two copper sheets and is copper welded. Sheets of center shell are silver-alloy brazed.

500-barrel copper brew kettles take super-size Anaconda copper sheet

The copper brew kettles you see here each hold 15,500 gallons of Miller High Life Beer. They are designed and fabricated to Miller's specifications by an old hand at brewery copper work—115-year-old Deckebach Sons Company of Cincinnati, a division of Brighton Copper Works, Inc. Deckebach called on the metallurgical and manufacturing abilities of Anaconda to produce the unusually large size copper sheet in the heavy sections they needed for the job. Anaconda copper sheets as large as 117″ x 234″ x .134″ were used.

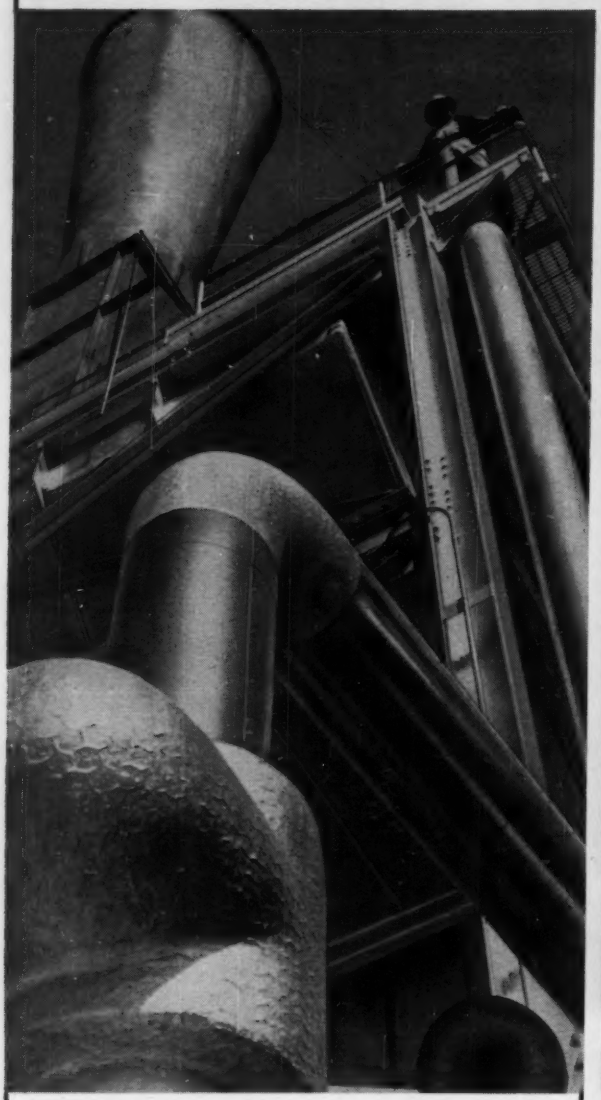
The kettles are made of copper; in addition, the bottoms are encased by steam jackets made from Everdur* circles 136″ in diameter and ½″ thick. Everdur is an Anaconda Copper-Silicon Alloy with high corrosion resistance. Each kettle and jacket contains about 7 tons of copper and Everdur. Body seams are silver-alloy brazed and the two-piece tops are copper welded.

Anaconda mills, warehouses and distributors throughout the country are always ready to give you fast service when you need copper, brass, bronze in sheet, plate, wire, rod and tube. At most locations, you can also have metal sawed, slit or sheared to exact sizes. If special problems arise, write directly to *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.* 55112

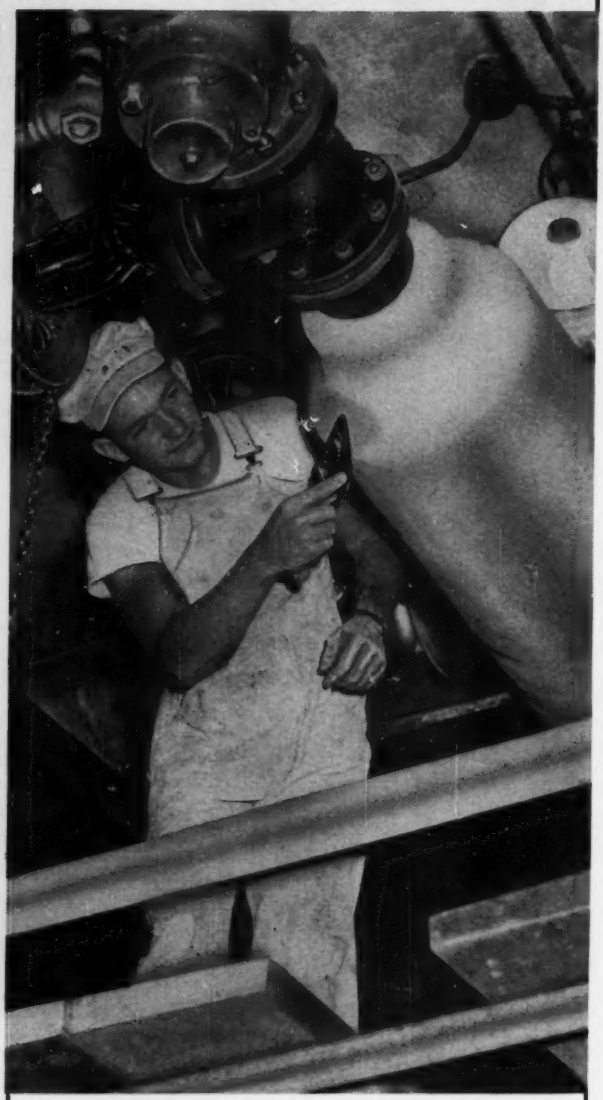
*Reg. U. S. Pat. Off.

ANACONDA®
COPPER & COPPER ALLOYS

FOR EFFICIENT CONTROL OF RISING INDUSTRIAL TEMPERATURES



KAYLO—*King of high temperature insulations*



FIBERGLAS—*World's leading industrial insulation*

Together they answer all your insulation needs!

Average temperatures of industrial processes have increased to 500-700° F. from 350-500° in the past several years. Indications are that they'll go even higher in the future.

With Fiberglas* and Kaylo® Insulations, present and future temperatures can be efficiently controlled without adding undue bulk or cost. Both products have exceptionally low "k" factors. They're strong . . . moisture-resistant . . . stable . . . easy to apply . . . cover the entire range from lowest sub-zero to 1200° F.

Kaylo is now distributed by Owens-Corning Fiberglas Corporation, and is available in quantity. For full technical data on Fiberglas and Kaylo, see Sweet's File, Chemical Engineering Catalog, or Refinery Catalog. Or write: Owens-Corning Fiberglas Corporation, Dept. 97-J, Toledo 1, Ohio.

OWENS-CORNING
FIBERGLAS

*T.M. Reg. Owens-Corning Fiberglas Corporation
® Kaylo is mfd. by Owens-Illinois Glass Co., Inc.

You get more than a sifter at

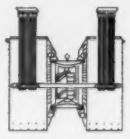
SPROUT-WALDRON

With the acquisition of Richmond Sifters, Sprout-Waldron offers one of the most complete lines of equipment for classifying, grading, and cleaning. This enables your Sprout-Waldron representative to be completely unbiased in his recommendation on the type of equipment best suited to your job. Moreover, he is thoroughly trained to help solve problems for the processing industries. Typical of our representatives is Ray Hubbard, shown here, with ten years of engineering sales experience in the processing industries. For the five years prior to joining Sprout-Waldron, Ray represented the sifting and classification machinery of Wallace & Tiernan.

RAY HUBBARD

Such men can provide professional advice and guidance that can help you lower production costs and raise the quality of your products.

RICHMOND-SPROUT-WALDRON SUPER-SIFTER



Ceiling suspended, free-swinging. Brings new concepts of accuracy, capacity, durability, cleanliness, and ease of maintenance to the separating of dry, pulverized materials. Available in 2, 4, or 6 sifting sections.

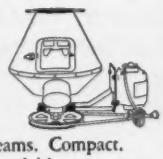
RICHMOND-SPROUT-WALDRON GYRO PEDESTAL SIFTER

Compact, high-speed. Designed for handling either batches or streams of free-flowing materials containing small percentages of oversizes. Installed in spouting, on columns or on wheels.

RICHMOND-SPROUT-WALDRON GYRO-LAB SIFTER

Duplicates results of large, production-type machines. Ultra-modern. Streamlined. Dust-tight. Two types. Provision for time limit sifting. Available with cabinet to keep spare screens.

RICHMOND-SPROUT-WALDRON STREAM SPLITTER



Accurately divides a single stream of dry, free-flowing material into 2 to 8 separate and equal streams. Compact. Economical. Dependable.

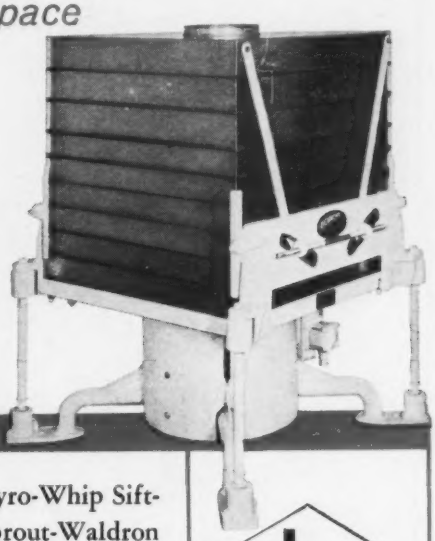
SPROUT★WALDRON

SW

MODERN SIFTING METHOD MAINTAINS UTMOST SANITATION

. . . reduces maintenance and cleaning
. . . saves floor space

RICHMOND-SPROUT-WALDRON
Gyro-Whip
SIFTERS

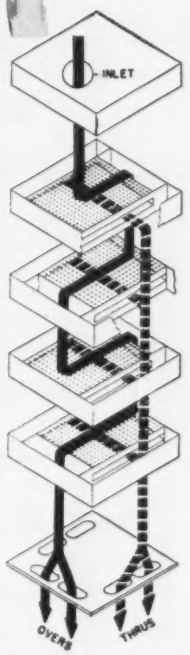


The famous Richmond Gyro-Whip Sifters — now part of the Sprout-Waldron line — are outstanding for their high capacity, low floor-space requirements, sanitary characteristics, and many advanced features.

Simplified design makes possible the most rigid standards of sanitation and reduces maintenance and cleaning time.

The average Gyro-Whip is only 48" high, requires only 3½′ x 3½′ floor space, and operates on only ¾ h.p. Bolting areas range from 47.5 up to 95 sq. ft. Sieves can be of stainless steel, wood, or wood lined with stainless.

The Richmond-Sprout-Waldron line includes models with single stacks of sieves . . . models with sieve stacks suspended from overhead . . . models mounted on pedestals . . . and laboratory models. Installation can be on the "stream." Shipped complete — ready to be connected and operated. Write for full details!



The directional flow for two separations is shown above. Coarse materials, or "overs," drop from sieve to sieve and are discharged through the "overs" channel. The finer particles, or "thrus," sift through to the sieve pans and pass into another channel. Modifications of sieve construction permit from 2 to 6 separations of a single product. Double discharge outlets prevent "backing up" of sifted materials.

SPROUT-WALDRON

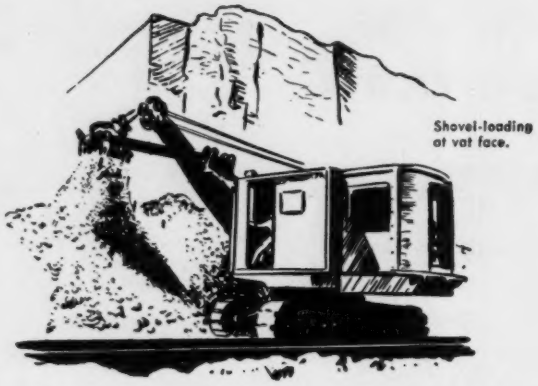
Manufacturing Engineers Since 1866

15 LOGAN STREET • MUNCY, PA.

Equipment for SIZE REDUCTION, MIXING & BLENDING, PELLETING & CUBING, BULK MATERIALS HANDLING, PRODUCT CLASSIFICATION

Facilities for fabricating, machining, custom founding, woodworking, laboratory testing

PR/4061



Shovel-loading at vat face.

Crude Sulphur

for Industrial Use

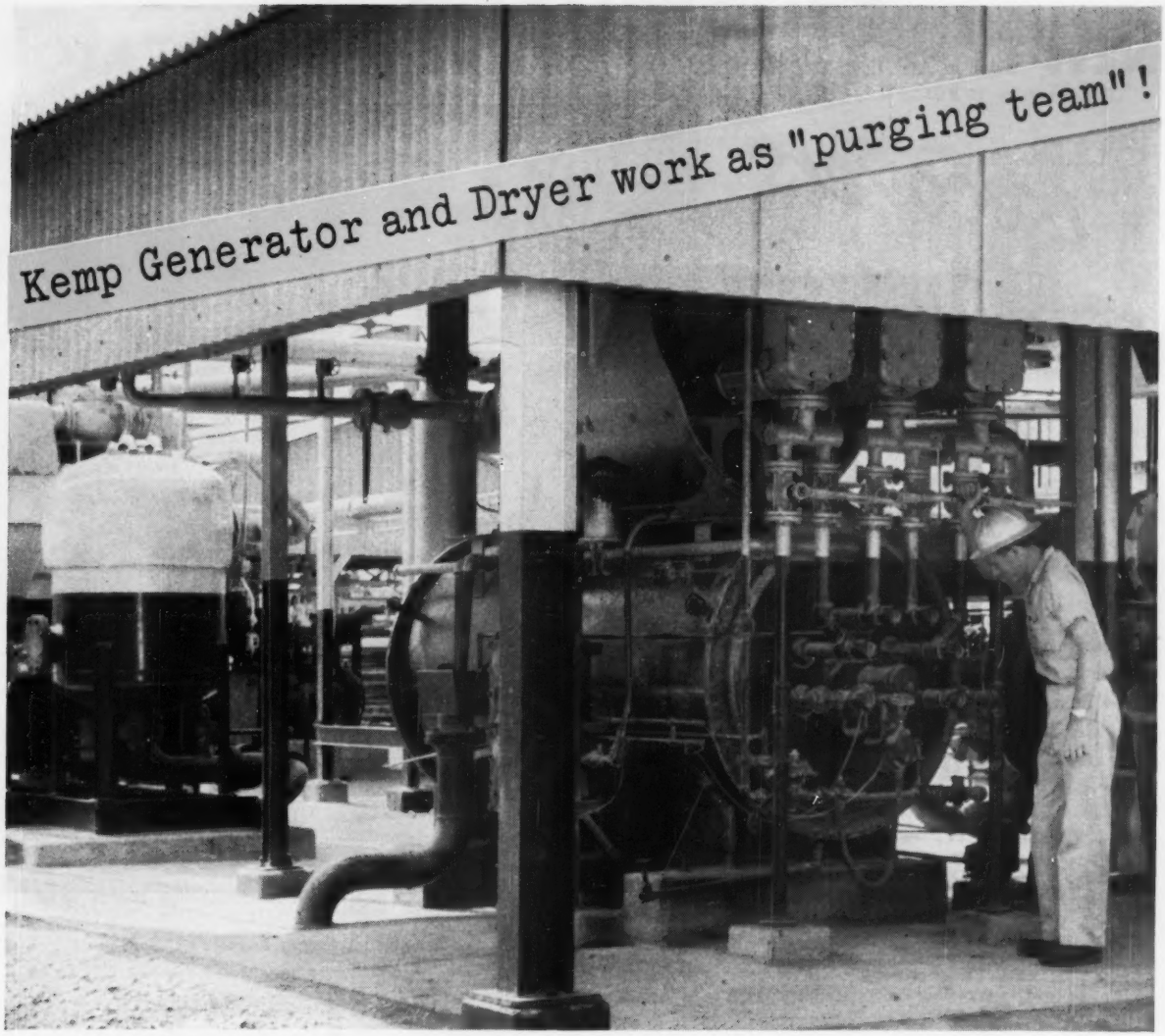
from the properties of

Texas Gulf Sulphur Co.

75 East 45th Street • New York 17, N. Y.

Producing Units

- **NEWGULF, TEXAS**
- **MOSS BLUFF, TEXAS**
- **SPINDLETOP, TEXAS**
- **WORLAND, WYOMING**



Gulf Oil Reports: *Pipe line purging problems solved by Kemp Gas Generator and Kemp Dryer*

At Gulf Oil's Port Arthur, Texas refinery, dry inert gas is required in the Ethylene Plant for purging pipe lines, tanks and vessels.

Kemp Units selected to do the job

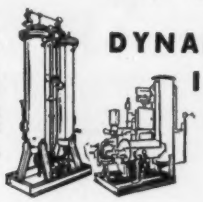
To insure a constant supply of gas—sufficiently dry and free of oil vapors—Gulf installed both a Kemp Inert Gas Generator and a Kemp Convection Type Dryer. The units work as a "purging team"...the Kemp Generator produces 30,000 SCFH of inert gas which is compressed and passed through a Kemp Pre-filter to remove all moisture prior to entering the gas receiver. The result is an efficient, easily controlled source of dry inert gas at all times.

Kemp can solve your problem too

Whether your needs involve dry gases, inert gases—or both, Kemp can help you to the most profitable solution. Kemp Inert Gas Generators automatically deliver clean, controlled atmospheres at specific analysis, without fluctuation—regardless of demands. A variety of Kemp Dryers are designed to dry air, gases or liquids to sub-zero dew points and are available with manual, semi-automatic or fully automatic tower reactivation. In addition, Kemp will specify the proper desiccant for the job.

For complete facts and technical information on Kemp Inert Gas Generators and Kemp Dryers, write today to: The C. M. Kemp Mfg. Co., 405 East Oliver St., Baltimore 2, Maryland.

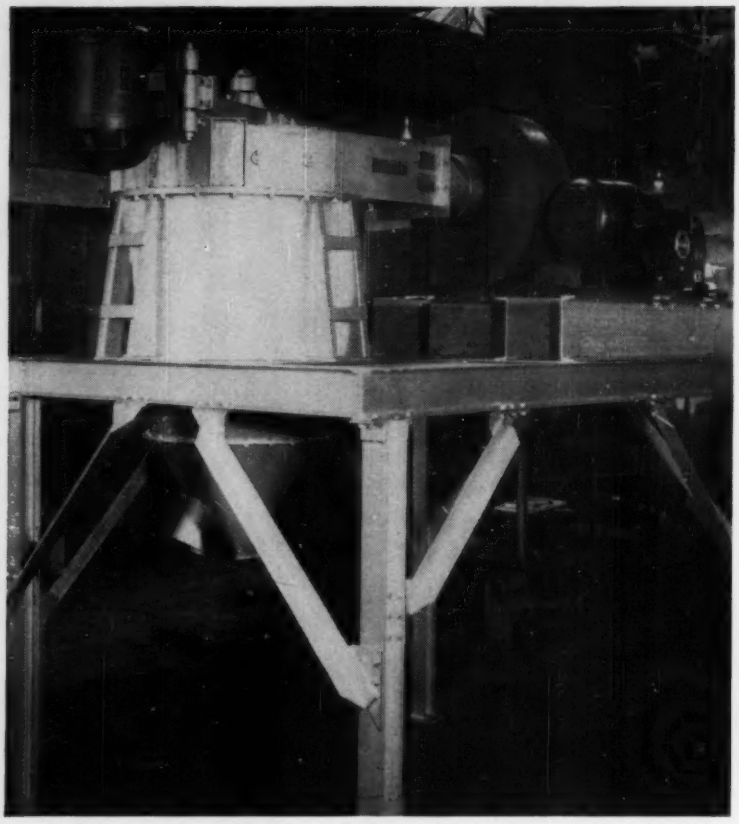
KEMP OF BALTIMORE



DYNAMIC DRYERS
INERT GAS GENERATORS
CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • SINGEING EQUIPMENT

NEW TYPE STURTEVANT AIR SEPARATOR

Recovers Fines in Micron Ranges



Now the famous Sturtevant Whirlwind Air Separator, so widely used throughout industry for fast recovery of fines, has been specially designed to "pick-off" classified materials such as pigments, limestone fillers, plastics, oyster shells, etc., in micron sizes.

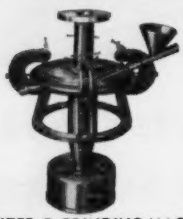
These highly efficient air separators select a continuously uniform product of desired fineness. Used in a closed circuit with grinding mills, they increase production, cut power costs.

Large feed opening, rugged construction, ease of adjustment, low power consumption assure economy of operation and minimum upkeep. Write for further information.

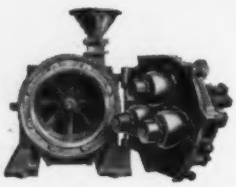
STURTEVANT
MILL COMPANY
100 CLAYTON STREET
BOSTON 22, MASS.

Designers and Manufacturers of:
CRUSHERS • GRINDERS • SEPARATORS
CONVEYORS • MECHANICAL DENS and
EXCAVATORS • ELEVATORS • MIXERS

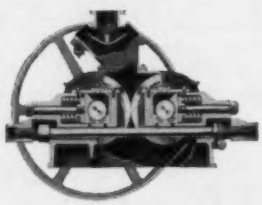
OTHER STURTEVANT EQUIPMENT



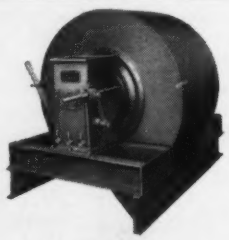
MICRONIZER ® GRINDING MACHINE
A fluid jet grinding machine, the Sturtevant Micronizer speeds reduction of materials to low micron sizes. These jet mills are especially applicable in fields where a particle size in microns is desired.
Sturtevant Micronizer grinding machines are available in many sizes and capacities.



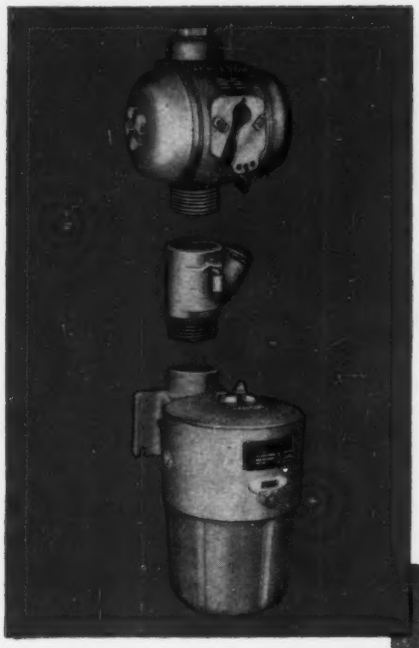
RING-ROLL MILLS
For medium and fine reduction (10 to 200 mesh), hard or soft materials. Very durable, small power. Operate in closed circuit with Screen or Air Separator. Open door accessibility. Many sizes. No scrapers, plows, pushers, or shields.



CRUSHING ROLLS
For granulation, coarse or fine, hard or soft materials. Automatic adjustments. Crushing shocks balanced. For dry or wet reduction. Sizes 8 x 5 to 38 x 20. The standard for abrasives.



BLENDER
Four-way mixing action assures a thoroughly blended product. Open-door accessibility permits easy cleaning. Available in many mixing capacities for ¼-ton per hour and up.



For complete protection . . . against explosion, dust, rain . . . use

APPLETON

Circuit Breaker, Motor Starter and Combination Motor Starter

UNILETS®

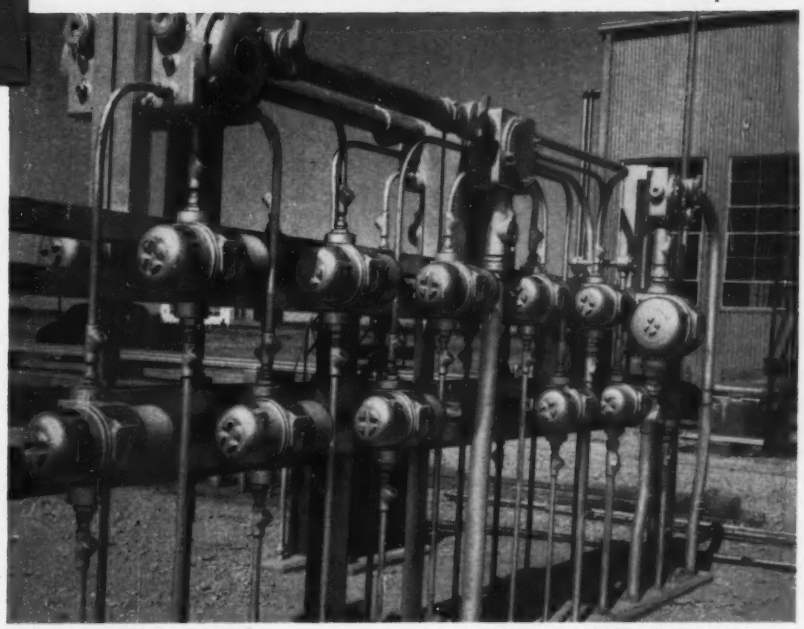


Photo courtesy Oil & Gas Journal

A typical bank of APPLETON Motor Starter Unilets in a main line booster station

More TOP-QUALITY features!

- First to be U.L. Approved for banked circuit breaker grouping
- Combinations meet U.L. requirements through approval of components
- No shut-downs while entering motor starter of a combination
- Full 7-thread Explosion-Proof protection
- Unmatched accessibility
- Compact, lightweight construction
- Units may be added quickly, easily
- Flexible field set-ups with single and duplex male and female hub adapters

Also Manufacturers of:

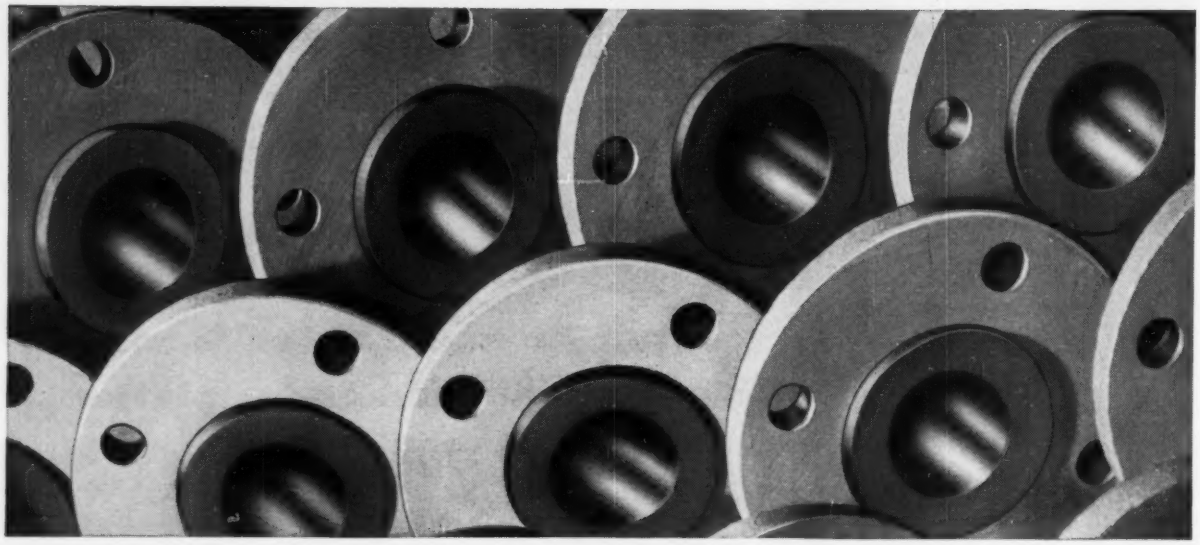
The biggest advancement in Explosion-Proof design in years! The design, construction and performance of APPLETON *Circuit Breaker and Motor Starter Unilets* give you maximum safety and unparalleled ease of wiring, installation and maintenance. You'll discover initial and long term savings plus many exclusive APPLETON features, not found in any other enclosure. Where absolute safety is required, regardless of the installation, APPLETON can serve you better! Send for Bulletin BH today for complete information!

Sold Exclusively Through Selected Wholesalers

APPLETON ELECTRIC COMPANY
1742 Wellington Avenue · Chicago 13, Illinois

Rely on* APPLETON *. . . the Standard for Better Wiring

DOW



You can see why

SARAN LINED PIPE

GIVES LONG, TROUBLE-FREE SERVICE

It's made of corrosion-resistant saran pipe swaged into steel for extra rigidity and strength . . . cuts downtime losses conveying corrosive liquids.

Now you can convey chemicals and many other corrosive liquids without worrying about costly shutdowns due to corrosion. For saran lined pipe, fittings and valves are corrosion-resistant . . . form snug, leakproof joints . . . which won't burst up to 150 pounds working pressure.

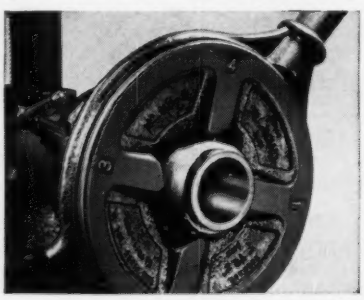
They're easily and inexpensively installed because they can be cut and threaded in the field with any standard pipe fitter's tools. Their rigidity means that few supporting members are needed.

Saran lined pipe, fittings and valves have a proved record in industry of bringing long trouble-free service. If your operation requires superior resistance to most chemicals and solvents, be sure to investigate saran lined pipe. Contact the Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale 20, Michigan, Department SP527A-2.

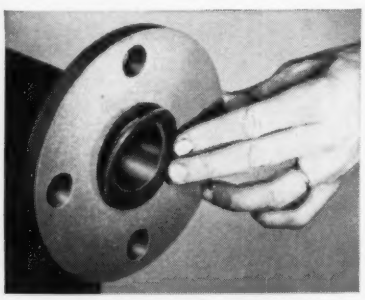
RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

Saran Lined Pipe Can Be Fabricated Right in the Field!

An adapted Beaver Cutter cuts away the end of the steel pipe so that ⅛" of the saran lining is extended. This assures a tight seal after a flange is applied and connected with another flange.



A ratchet type thread cutter makes the standard threads after the Beaver Cutter has been used. A flange or union fitting is attached and tightened until the liner is flush with the fitting.



If two flanges, or a union fitting, are used to make a pipe connection then a full gasket is required. If a flange is made up against a flange fitting or spacer then a half gasket is required.

Saran Lined Pipe is Manufactured by
The Dow Chemical Company, Midland, Michigan

you can depend on DOW PLASTICS

DOW

Lapp Valves are Solid Porcelain

You need to make no compromise with contamination or corrosion from valves in chemical processing. Lapp valves are of *solid* Lapp Porcelain, a material unique as a ceramic for industrial scale chemical service. It alone offers the following combination of characteristics and qualities:

PURITY • Lapp Porcelain is a potassium aluminum silicate, made from selected clays, flint and feldspar...has no free iron or other metallic impurity.

NON-POROUS • Complete vitrification of all sections, through firing to 2300°F., provides *zero* porosity. No dye penetration of body in 100,000 psi test. No chemical can penetrate in service.

HIGH MECHANICAL STRENGTH

Compression strength .....100,000 lbs. per sq. in.
Tensile strength ..... 8,000 lbs. per sq. in.
Modulus of rupture ..... 15,000 lbs. per sq. in.

CHEMICAL RESISTANCE • Lapp Porcelain is unaffected by any acids except HF. It provides years of trouble-free service, handling hot acids in all concentrations, as well as mixed acids and other troublesome combinations.

UNIFORM QUALITY • Lapp Porcelain has been manufactured for 38 years for use in most severe chemical, electrical and mechanical services. Plant facilities include Lapp-patented vacuum processing, deaerating pug mills, two continuous tunnel kilns, and complete chemical, electrical and mechanical test equipment.

Write for bulletin with complete description, characteristics, and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 419 Wendell St., LeRoy, N. Y.

An electrical test is the most searching inspection for physical soundness! Porcelain bodies for Lapp valves above are being flashed over—at 70,000 volts for three minutes. Any physical defect is revealed as an electrical puncture.

Y-valves, angle valves, flush valves, safety valves, and plug cocks of Lapp Porcelain have standard bolt-circle flanges for easy connection to all piping and equipment.

Lapp

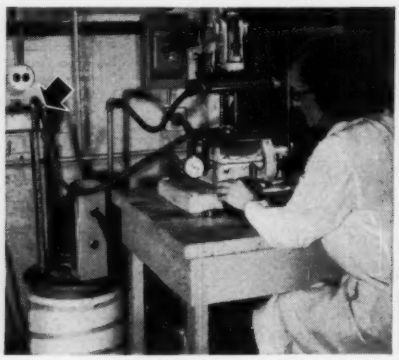
PROCESS EQUIPMENT

Chemical Porcelain Valves • Pipe • Raschig Rings
Pulsafeeder Chemical Proportioning Pumps

PLATENS . . . Injection molding machine has platens heated by water which is circulated at a temperature of 180°F from tank equipped with a 2500 W Chromalox immersion heater. There are 18 machines on this production line operating 24 hours a day, five days a week . . . some for over six years.

STAMPING DIE . . . Trade name is imprinted on rubber, nylon and plastic AJAX combs with this stamping machine. Each of the four machines is equipped with a 450 W Chromalox cartridge heater. Heating cycle is about one-half second—operating eight hours a day, five days a week.

HEATING OIL . . . In the Vulcanized Rubber and Plastics Company's laboratory, a 2 KW Chromalox immersion heater raises the temperature of the oil in the kettle to 180°F. When in operation the heated oil is circulated continuously through platens in the machine that they use for testing pills.



PREHEATING . . . Metal clips for AJAX combs are heated by two 250 W Chromalox cartridge heaters to 200°F in a 30-second heating cycle on two machines. The prongs of the clips are then forced through the rubber and plastic comb material by mechanical pressure—eight combs at a time.

Vulcanized Rubber and Plastics Company solves heating problems electrically

. . . obtains low cost operating performance

Fifteen years ago the Vulcanized Rubber and Plastics Company, Morrisville, Pennsylvania, converted the heating of platens from steam to electric, in order to obtain the dry heat required for molding rubber. Results proved so successful that today this company has a long line of 72 electrically heated rubber molding presses—using Chromalox Electric Heaters.

As their plant expanded, the company added other operations that required precisely controlled heat—in varying amounts and temperatures—some of which are shown here. They readily solved each heating problem by using the specific type and size of Chromalox Electric Heater best suited for each operation.

Results over a period of years show many cost saving advantages, such as: low installation cost; clean electric heat; long heater life; continuous production. Plus automatic operation, by which temperatures are varied with ease; maintained precisely—right at the spot where the heat is used.

This company's experience is typical of how we can help you solve your heating problems. Always available to you, for example, are our research, engineering, design and modern manufacturing facilities—the result of thirty-eight years' experience in the manufacture and application of electric heaters in practically every industry and process using heat to temperatures of 1100°F.

Let us know your problem for controlled heat, and our Sales Engineering staff will go all out to help you find the right answer—electrically.

For information on the complete line of Chromalox Electric Heaters and Controls, write for your copy of Catalog 50.

Edwin L. Wiegand Company
7514 Thomas Boulevard • Pittsburgh 8, Pennsylvania

DRYING OVEN . . . Metal parts, that are to be cast in rubber in the rubber molding presses, must be completely clean and dry when they are put into the production line in the molding room. After they are thoroughly washed, the metal parts are put into an oven to be completely dried. To maintain a constant temperature of 280°F, the oven is equipped with ten 750 W Chromalox strip heaters. These strip heaters have the excellent performance record of having been in operation eight hours a day, five days a week, for over four years—with no failures.

TANKS . . . Plastic handles, produced by two injection molding machines, come from the dies at 400 to 600°F. To hold them at sufficient heat to prevent shrinkage requires two stages. First stage is to put them through the tank shown in foreground, which is kept at 180°F by four 750 W Chromalox strip heaters. Second stage is to soak them in the tank in background, which is kept at 180°F by a 2500 W Chromalox immersion heater—until time for degreasing and packing. To maintain production, these baths are in operation on a schedule of 24 hours a day, five days a week.

PLATENS . . . Used for molding rubber wheels around metal hubs, this press is equipped with six 450 W Chromalox strip heaters in both top and bottom platens—and eight 150 W Chromalox strip heaters, covered with insulation, on the outside of the die. Heated parts are kept at 380°F, in a 20-minute heating cycle. Fifteen years ago, this company converted from steam to electric platens. Results proved so satisfactory they now have 72 presses, which have been operating 24 hours a day, six days a week for approximately one year—with practically no failures.

WHAT'S THE PRICE OF THIS AGITATOR?

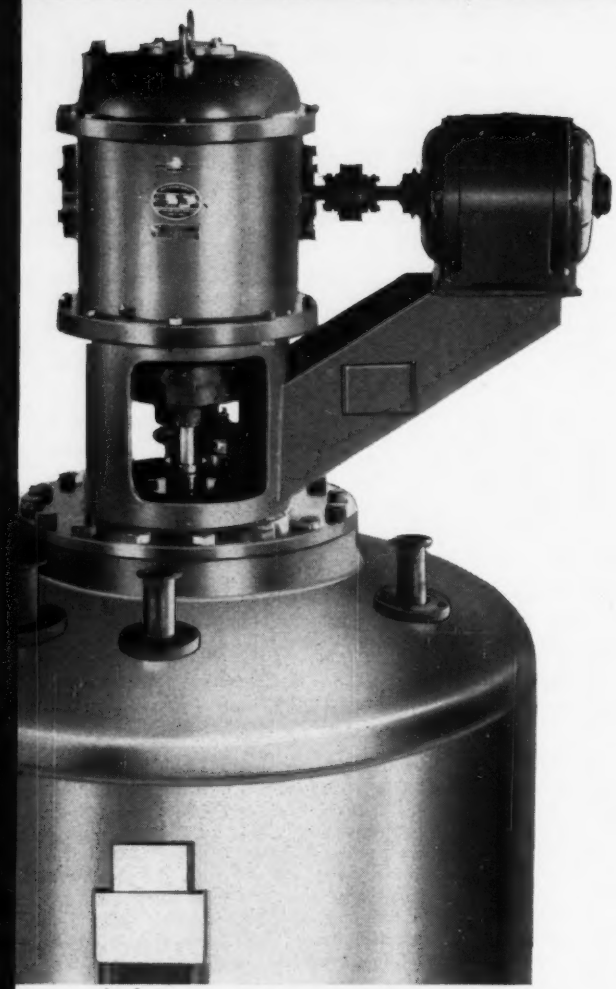
There are three "price tags" that add extra value to the purchase price of a Nettco Agitator. These are:

The engineering "price tag" — your assurance the Nettco drive is the right size, the right speed, the right horsepower, the right shaft diameter — backed by Nettco's over 50 years of serving the agitation needs of Industry.

The operating "price tag" — your assurance the Nettco unit is engineered for low power consumption and high productivity — two vital economy factors in any processing system.

The maintenance "price tag" — your assurance the Nettco drive will minimize maintenance: with a minimum of moving parts — all conservatively rated.

Next time use Nettco — for engineered agitation that's lowest cost in the long run. Send for data and recommendations, to New England Tank & Tower Company, 87 Tileston St., Everett 49, Mass.



Installation of Nettco Agitators in new multi-million dollar dyestuffs plant — **complete plant served by Nettco Engineered Agitation.**

HELPFUL NETTCO CATALOGS

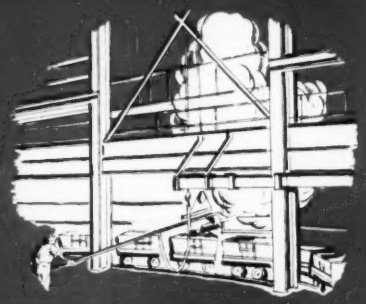
General Catalog No. 530
Side Drive Agitators, Bulletin No. 532
Nettco Flomix®, Bulletin No. 531

NETTCO
ENGINEERED AGITATION

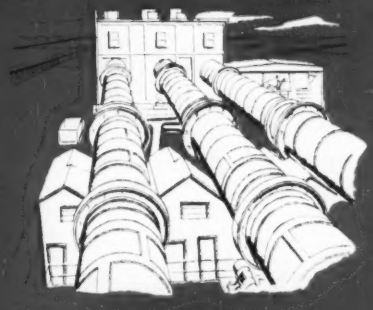
Harbison-Walker
REFRACTORIES

serve every chemical processing need

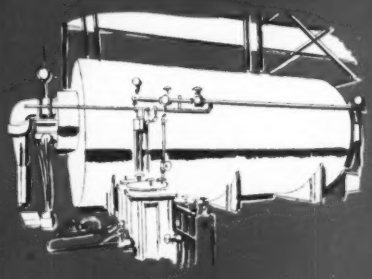
To meet the wide variety of conditions that prevail in chemical processing equipment, Harbison-Walker provides a complete line of refractories from which can be selected the exact types and classes needed for longest life and most economical service. Technical service based on the most extensive experience and research is freely offered for assistance in determining the proper refractory for every specific requirement.



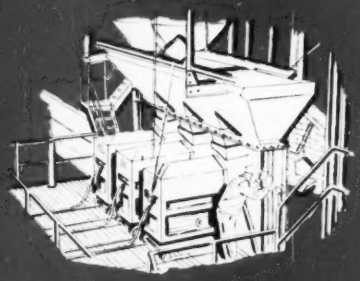
CALCIUM CARBIDE FURNACE



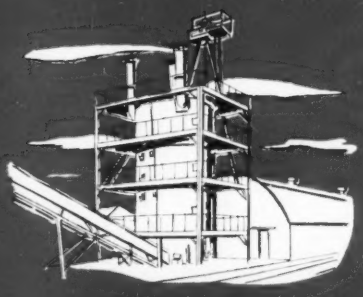
ROTARY KILNS



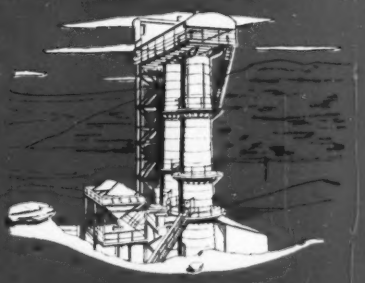
SULPHUR BURNER



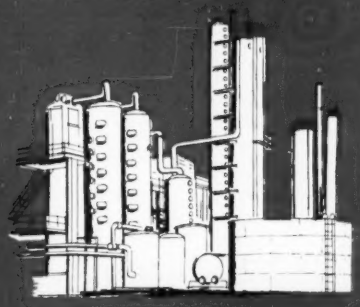
SILICATE OF SODA FURNACE



ROASTER FURNACE

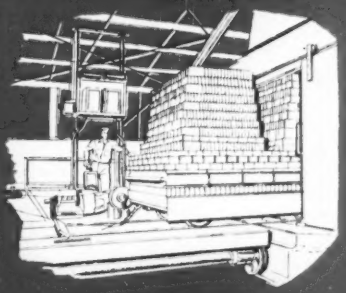


SHAFT KILN



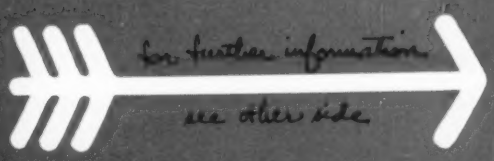
TOWERS AND TANKS

BOILER FURNACE



TUNNEL KILN

HARBISON-WALKER REFRACTORIES CO.
and Subsidiaries
WORLD'S LARGEST PRODUCER OF REFRACTORIES
GENERAL OFFICES: Pittsburgh 22, Penna.



Harbison-Walker Products

for greatest durability and economy in all refractories applications

The true cost of refractories is not measured by their cost per thousand. The proper criterion for the value of a refractory material is its effect upon the overall costs of production per unit of output—whether it be a ton of chemicals, a pound of titanium, or a unit of any other product. Obviously it is very important that refractories be selected with extreme care in order that the kind best suited for the particular operating conditions be used to secure maximum service life with the least maintenance interruption and production loss.

Harbison-Walker produces more than fourscore types and classes of refractories from which can be made the best balanced selection. Four general classifications are illustrated below.

Bonding Mortars with characteristics matching the brick assure most satisfactory service.

Refractory Brick and Mortars

The types of Harbison-Walker dense refractories used in the chemical processing industries include high-alumina and fire clay (all classes), basic (magnesite, chrome and forsterite), silica (super-duty and conventional) and chemical-proof brick.

Harbison-Walker makes insulating fire brick (six brands), lightweight silica brick, block insulation and castables of high insulating value.

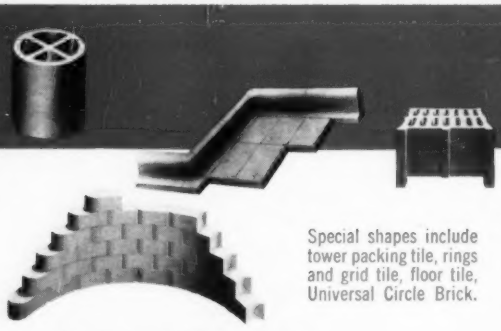
Insulating Refractories

For the insulation of industrial furnaces many combinations of insulating fire brick and other refractories may be used with greatest advantage. With the full complement of insulating fire brick and refractories of all kinds, Harbison-Walker can furnish the correct combination for any service requirement.

Plastic fire brick are available in both standard and super classes. Castables in a dozen specialized classes.

Plastic and Castable Refractories

For many applications, monolithic furnace linings are used with good economy. Harbison-Walker offers the complete range of refractory materials in plastic and castable forms for such needs. Castables may be poured like concrete, trowelled, rammed or installed by air-gun application.



Special shapes include tower packing tile, rings and grid tile, floor tile, Universal Circle Brick.

Acid-Proof Materials

Duro acid-proof brick and shapes are dense and vitreous, strong and abrasion-resistant, highly impermeable to gases and liquids, resistant to corrosive chemicals, and have refractoriness adequate for temperatures up to 2300°F. They are extensively used in a wide variety of chemical processing applications.

see other side

HARBISON-WALKER REFRACTORIES CO.

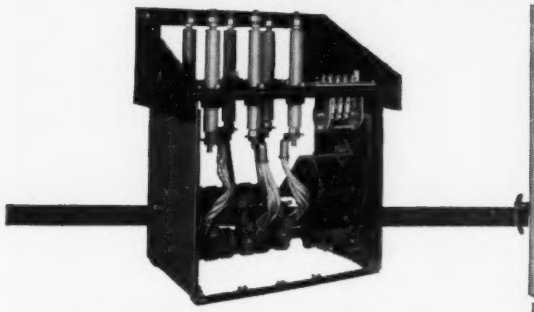
and Subsidiaries

WORLD'S LARGEST PRODUCER OF REFRACTORIES

GENERAL OFFICES: Pittsburgh 22, Penna.

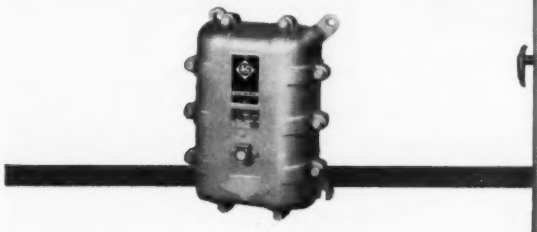
These Safety Features

meet operating demands of combustible atmospheres



Oil-immersed main contactor for safe operation

The complete contactor, including magnet and auxiliary switches, operates under oil to prevent sparks from igniting atmosphere and to protect mechanism from corrosion.



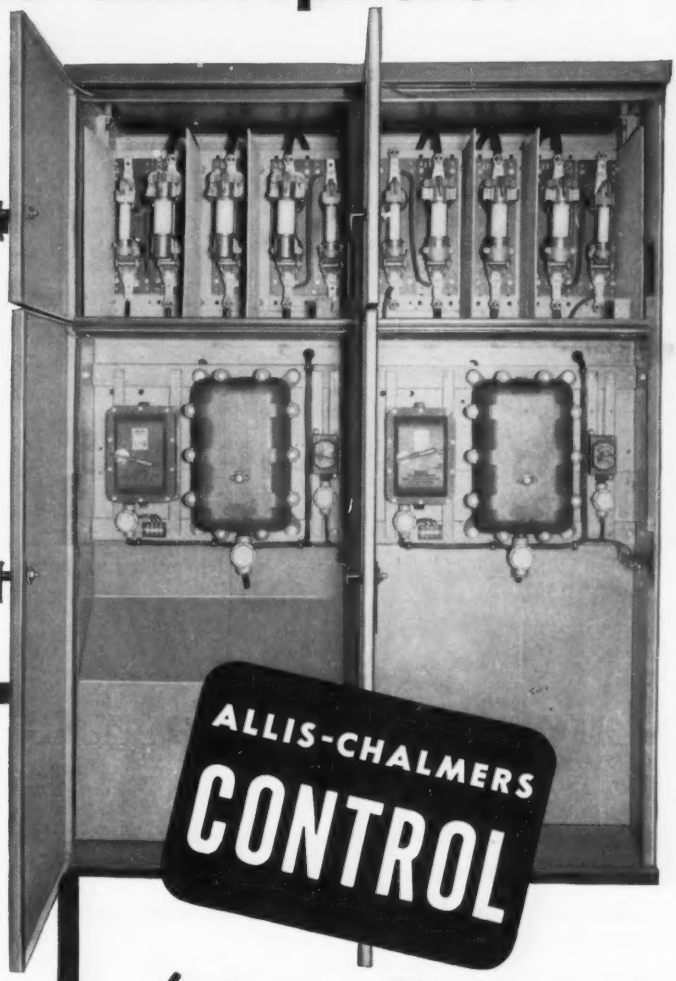
Relays and switching devices in explosion-proof cases

Further protection against the possibility of explosion is provided by NEMA VII enclosure which houses all overload, undervoltage, timing and auxiliary control relays as well as other low voltage switching devices.

Interlocked fuse compartment door

The fuse disconnect door is interlocked. The line contactor must be opened before access to the fuse is possible.

Other features *Steel barriers* in rear compartment prevent accidental contact with high voltage parts. Enclosure is finished with corrosive-resistant paint. Indoor or outdoor control equipment may be provided.



Industry-Engineered

for Semi-Hazardous Locations

Type H starters for 2300 to 5000-volt motors

For complete information, see your Allis-Chalmers representative or write Allis-Chalmers, Milwaukee 1, Wis.

A-C ALLIS-CHALMERS

A-4583

ALLIS-CHALMERS

SEPARATION of liquid and gas—an important step in this new plant where byproduct SO_2 gas is converted into valuable . . .

A CHEMICAL ENGINEERING PICTURED FLOWSHEET

Liquid Sulfur Dioxide

Three new process units—low temperature oxygen generation, flash-smelting of copper ores, and SO_2 compression—combine here in a smooth-running operation.

Integrating newly designed processes into a smooth-running operation is usually a tricky, complicated business.

At Copper Cliff, Ont., there's a new chemical plant which stands as a prime example of successful integration. This is Canadian Industries Ltd. 90,000 ton/yr. liquid SO_2 plant.*

CIL makes SO_2 by compressing and cooling. But this operation is closely tied in with an adjacent International Nickel Co. of Canada copper plant. At Inco, SO_2 gas is produced by oxidation of copper sulfide ores.

Briefly, liquid SO_2 production depends on three novel process units. Each contributes to the over-all picture—the successful conversion of waste gas into a valuable product:

• Liquid air unit. This is a Oxyton design, built by Canadian Liquid Air for Inco. It has a capacity of 325 ton/day of 95% oxygen. Nitrogen expansion provides the refrigeration—no ammonia cycle is used.

• Oxygen flash-smelting furnace. Here copper ore concentrates (sulfides) are injected with oxygen into a Inco designed furnace, producing matte, slag and a gas containing 75% SO_2. The furnace handles 1,000 ton/day of concentrates. No fuel, other than O_2 is required.

• SO_2 compression. The SO_2 gas comes into CIL's plant by pipeline. Operating at around 400 psig., the gas is filtered, dried, compressed to a liquid and cooled.

The over-all operation feeds on some basic raw materials—air, and ore concentrates (see flowsheet).

▶ **How Oxygen Is Made**—Air, compressed to about 65 psig. is cooled in an after-cooler and scrubbing tower. It then goes through the regenerators, where it is cooled to the dewpoint.

In a high pressure column (65 psig.) a rich liquid of about 40% oxygen is taken off as bottoms. Gaseous nitrogen comes off overhead. After partial condensation, it is warmed in a liquefier. Then it enters expansion turbines, where pressure is lowered to about 1 atm. This nitrogen joins the stream coming off the low pressure column.

Rich oxygen liquid (40%) is filtered, then cooled with nitrogen to −304 F. It passes through an expansion valve, into the medium pressure (30 psig.) column. Here a liquid of 55% oxygen comes off as bottoms.

After cooling, the oxygen liquid flows to the low (3 psig.) pressure column. Here essentially pure oxygen is produced for the furnace smelting operation.

▶ **Preparing the Furnace Feed**—Drying of all ore solids is accomplished in three separate air-borne systems, handling copper and pyrrhotote (FeS) concentrates and flux. The copper drying system has a capacity of 54 ton/hr., uses three 4-ft. dia., 18-ft. long drum dryers. Dry material is recovered in dry cyclones, while any gas is handled in wet cyclones. Exit gas temperature is around 400 F.

▶ **Furnace Operation**—Gravimetric belt and rotary feeders provide a properly proportioned mix of concentrates and

* Most of the liquid SO_2 goes to sulphite paper mills in the Ontario area, replacing sulfur.

sand to screw conveyors, then to air-locks.

The furnace operates at 2,250 F. It is 68-ft. long, 24-ft. wide, 17-ft. high, and handles 1,000 ton/day of concentrates. Roof and side-walls are chrome magnesite, while the bottom is magnesite brick.

At the burner, solids enter the oxygen stream at a pipe junction, then go to the burner. A water-jacket surrounds the burner to prevent burning of the tip.

The gases leaving the furnace stream are oxygen-free, averaging about 75% SO_2—the balance being mainly nitrogen.

▶ **Cleaning the Gas**—There is a major problem involved in producing liquid SO_2 from this furnace gas. It must be cooled from 2,200 F and cleaned to less than 0.003 grains of dust/cu.ft. This is accomplished by settling, water scrubbing and electrostatic treatments.

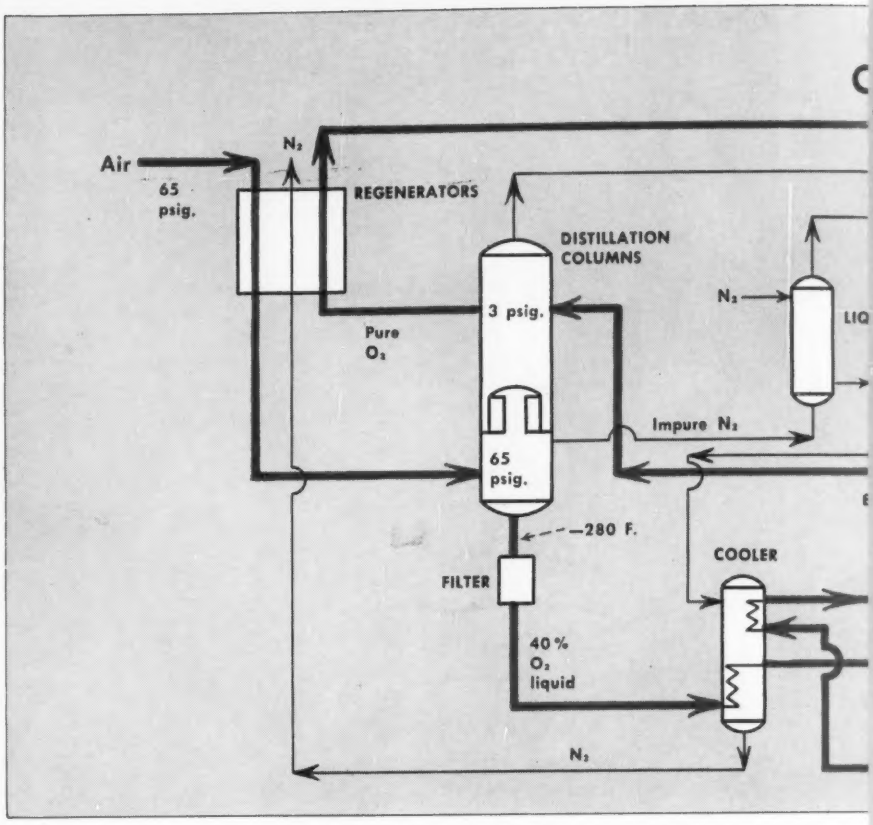
First, the dust-laden gas enters a settling chamber. A major part of the dust settles here, and the temperature drops to 1,200 F. Then the gas enters a 4 by 17 ft. water spray tower. The sludge from this drains to a settling cone, and the overflow from the cone recycles to the spray tower.

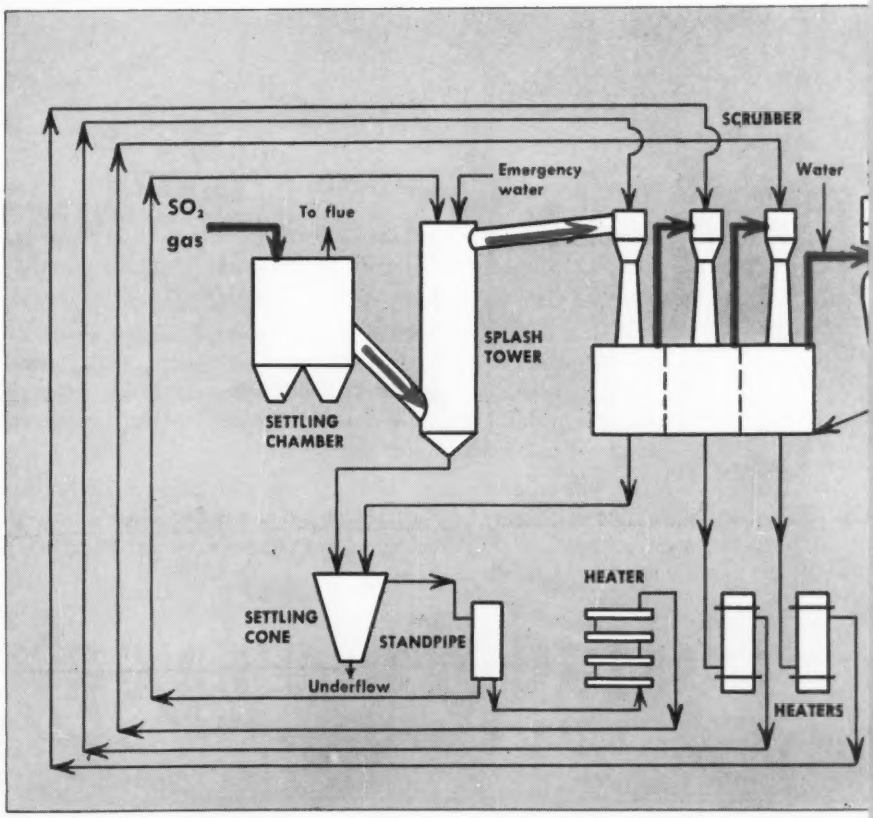
Water saturated gases pass through three venturi scrubbers—water-spray flows countercurrent to the gas and is cooled in heat exchangers between each of the three stages. Final cleaning is handled in a Cottrell precipitator for removal of residual SO_2 fumes. The entire cleaning system is served by a 3,600 rpm. 200 hp. centrifugal fan.

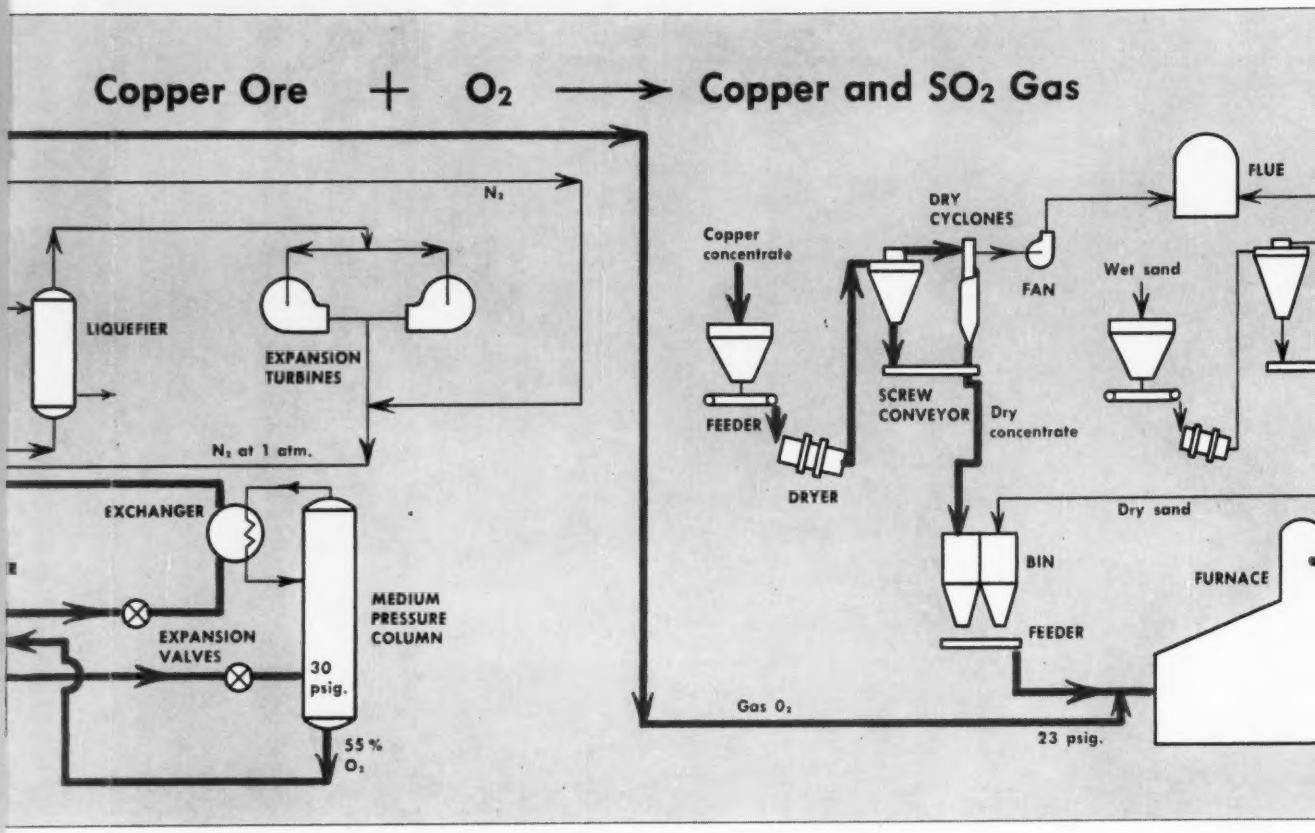
All cleaning equipment is made of stainless steel and lead. A 16-in. dia., 1,500-ft. line delivers the cleaned gas to CIL.

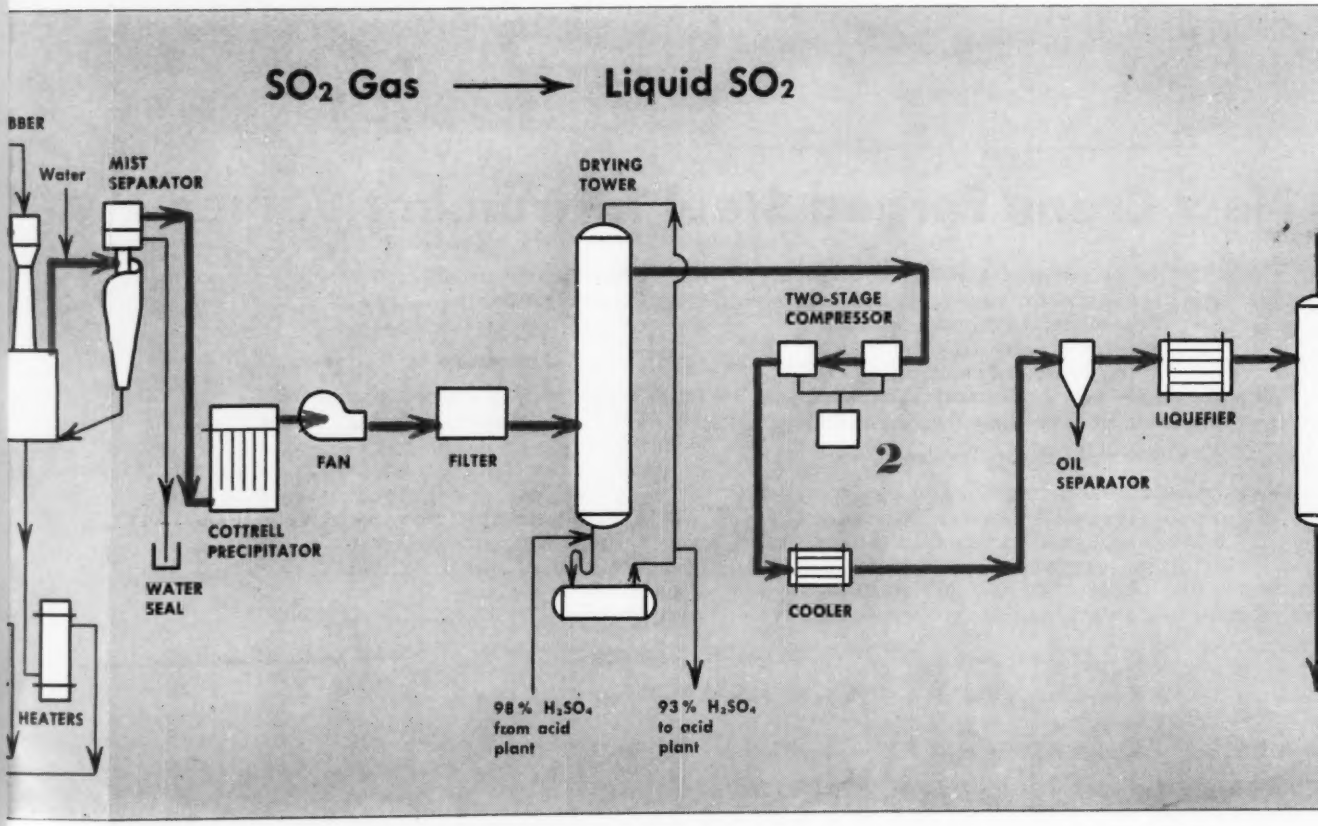
▶ **Making Liquid SO_2**—First the gas is filtered through glass wool. Then it is scrubbed with 93% sulfuric acid in a drying tower. Make-up 98% sulfuric comes from an adjacent CIL acid plant.

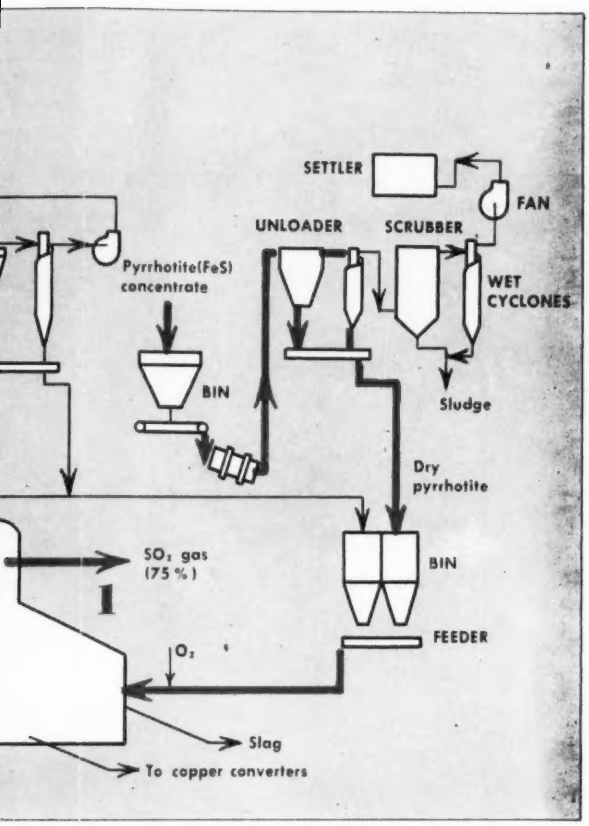
Two-stage compression brings the gas up to about 400 psi. Oil is removed in a separator, and the compressed gas then flows to a liquid-cooled heat exchanger. After cooling, some liquid is taken off in a separation tower. Uncondensed SO_2 is put through a single-stage compressor. Again oil is removed in a separator. Cooling condenses out more SO_2, which is removed in a second tower

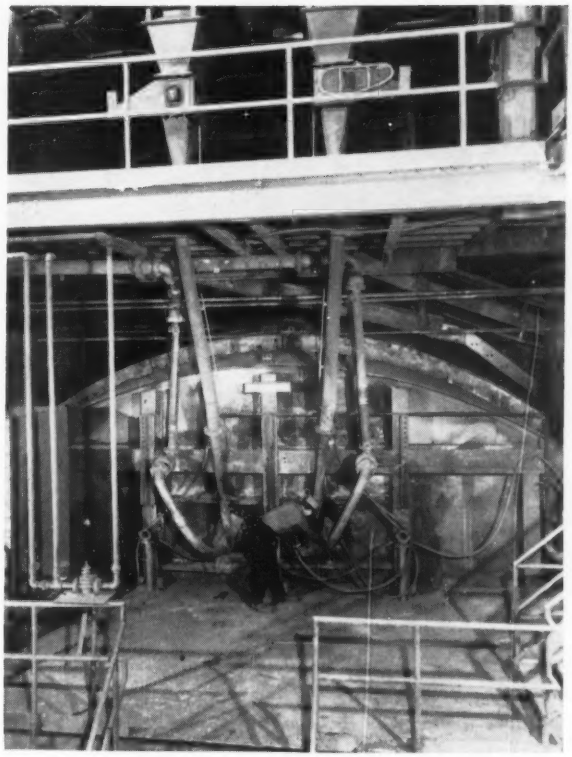




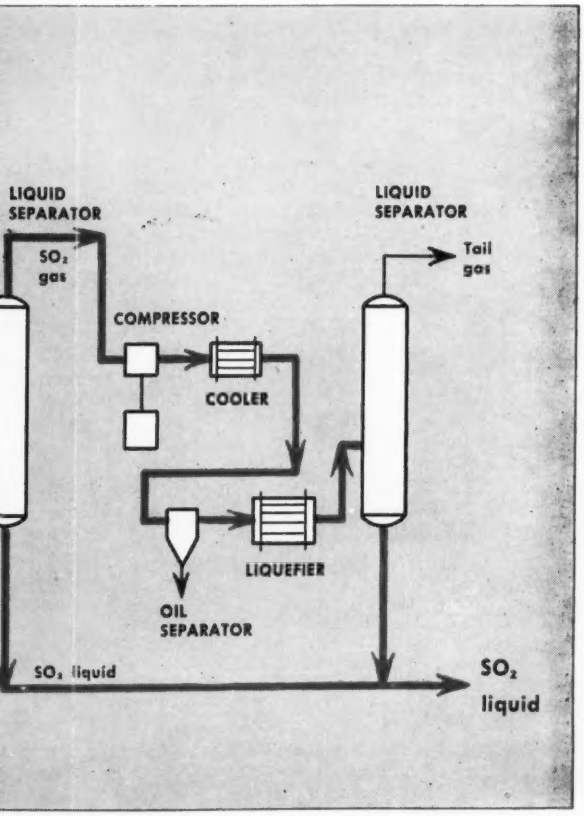

Copper Ore + O_2 ⟶ Copper and SO_2 Gas
N_2
LIQUEFIER
EXPANSION TURBINES
N_2 at 1 atm.
EXCHANGER
EXPANSION VALVES
MEDIUM PRESSURE COLUMN
30 psig.
55 % O_2
Copper concentrate
FEEDER
DRYER
DRY CYCLONES
FAN
FLUE
Wet sand
SCREW CONVEYOR
Dry concentrate
Dry sand
BIN
FEEDER
FURNACE
Gas O_2
23 psig.

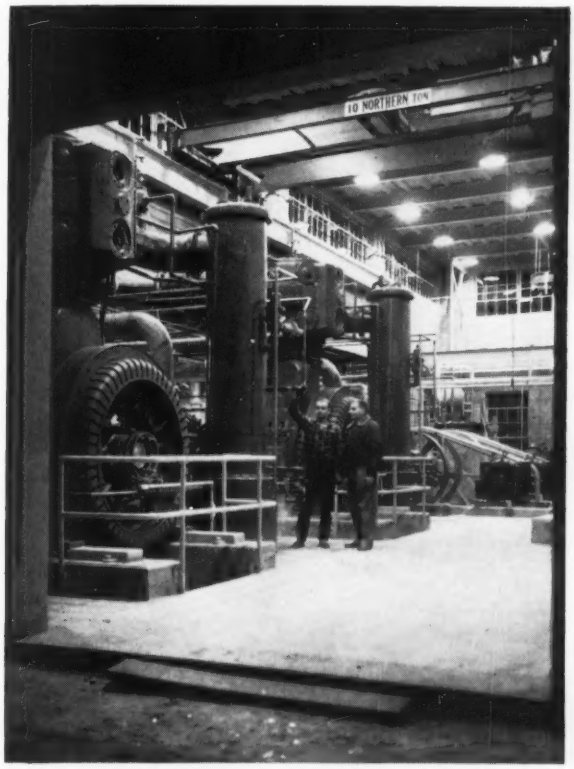

SO_2 Gas ⟶ Liquid SO_2
Water
MIST SEPARATOR
COTTRELL PRECIPITATOR
WATER SEAL
FAN
FILTER
DRYING TOWER
TWO-STAGE COMPRESSOR
2
COOLER
OIL SEPARATOR
LIQUEFIER
HEATERS
98 % H_2SO_4 from acid plant
93 % H_2SO_4 to acid plant





1 FLASH FURNACE, showing the feed pipes extending from the burners up to the dry ore feeding system.





2 SO_2 COMPRESSION is handled by reciprocating compressors. The gas is then cooled, forming liquid SO_2.

DO *YOU* TAKE GASKETS FOR GRANTED?

In the costly processes of today's industry — where fluids are confined in searing heat and brutal pressures — taking a gasket for granted is serious business. The price of gasket failure is measured in damaged equipment, plant "down-time", danger to personnel.

No one at Flexitallic has ever taken a gasket for granted. Each Flexitallic Spiral-Wound Gasket is engineered to be the right gasket for the right flange for the right seal. For 43 years, Flexitallic has worked toward perfecting this principle. Small wonder more and more engineers are specifying on orders: "Flexitallic — do not substitute".

Each Flexitallic Gasket is designed and engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". In diameters to 84" O. D.

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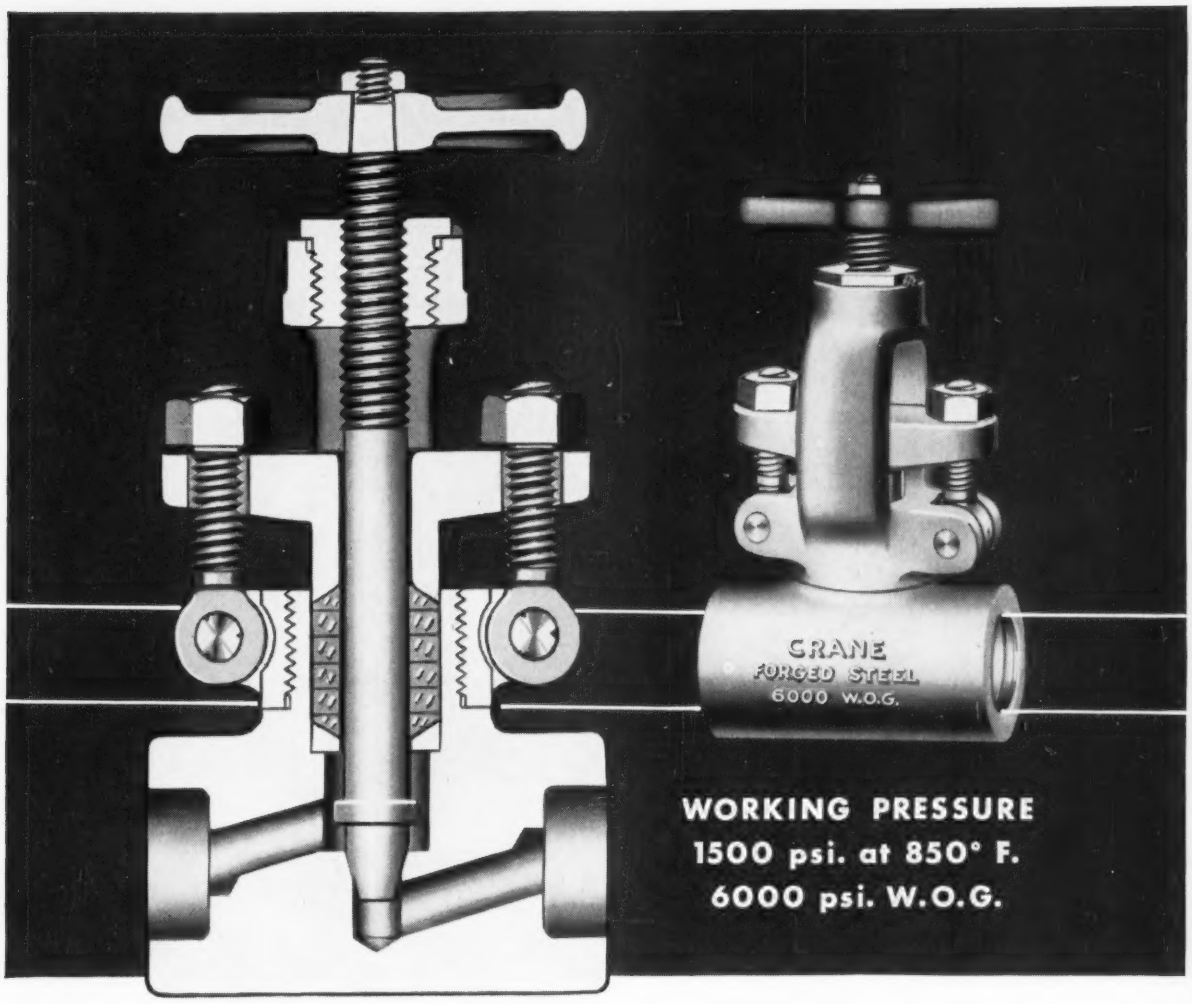
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

TEFLON FOR PROCESS APPLICATIONS

The ideal seal for many process applications is a Flexitallic Gasket with Teflon trapped between edges of stainless steel. Ask for folder, "Teflon in Flexitallic Gaskets."

*Not all spiral-wound gaskets are Flexitallic. Look for *Flexitallic Blue* —it's our exclusive blue-dyed Canadian asbestos filler.

Now Available



New Crane Forged Steel Instrument Valves

Been looking for an exceptionally rugged, compact, and low-priced stop valve for your small hydraulic or high-pressure, high-temperature instrument lines?

Crane has developed it—sizes ¼", ⅜" and ½", in both screwed and socket-welded patterns. It's the all-new Crane Forged Steel Instrument Valve, and you can specify it now for immediate delivery.

Will Handle Many Services

Note closely the over-all design and construction shown above of this new Crane valve. Oversized stuffing box—heavy-duty Crane Exelloy stem with integral disc—bolted gland—swinging gland eye bolts—outside screw and yoke construction—all add up to the high performance and low maintenance you want in a valve for your instrument panels, orifice meters, bypass and gauge lines, regulator leads, and other hydraulic and high pressure/temperature lines.

Literature on Request

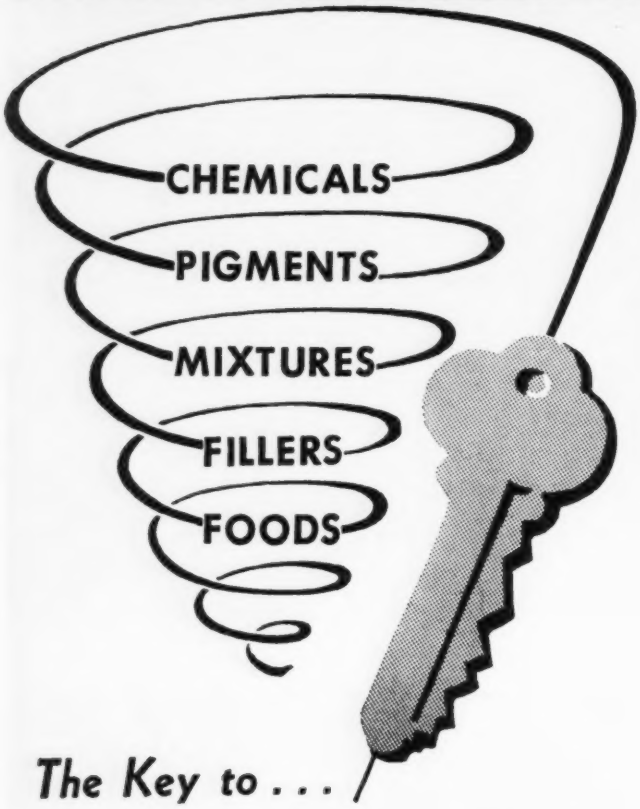
These rugged, low-cost stop valves are built for 1500 psi. at 850° and 6000 psi. W.O.G. Construction and materials are job-engineered by Crane experts—backed by a century of quality manufacturing, matchless experience. You'll want complete information on the all-new Crane Forged Steel Instrument Valves. Contact your Crane Representative, or write to Crane Co., General offices, Chicago 5, Illinois—Branches and Wholesalers serving all industrial areas.

CRANE CO.

VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY...1855-1955

RAYMOND *Whizzer* SEPARATION



The Key to . . .

Premium Products

RAYMOND Mechanical Air Separators . . . with built-in revolving Whizzer . . . are highly efficient for classifying fine grade powdered materials, required to meet exacting specifications in the chemical, food and process industries.

The Whizzer feature gives close control of the finished fineness over a wide range from about 50-mesh to 99.9% passing 325-mesh. Some installations are producing sub-sieve materials in the lower micron sizes. These units are equally adaptable in making superfine end products, or in dedusting special materials to remove objectionable fines.

Whizzer separation insures cleaner, faster classification of the material, and maintains uniformity of the finished product within close limits. If you have a special problem, Raymond engineers can help you in setting up economical production methods.

Built in sizes from 4'0" to 18'0" diameter with a Single Whizzer or Double Whizzer (as shown). Also a 30" Separator and Laboratory 10" Air Separator.

For further details, see Bulletin No. 76

RAYMOND BOOTH #68
AT THE CHEMICAL SHOW

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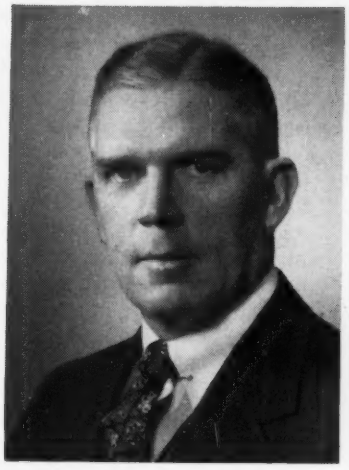
Combustion Engineering - Superheater, Ltd., Montreal, Canada.



Samuel Lenher

David H. Dawson

Du Pont Executives: Men of the Month

Chemist and chemical engineer become vice presidents, directors and members of company's executive committee.

The specs for a job on Du Pont's executive committee, are drawn pretty tight—and they have to be. The ten-man panel sets broad, basic operating policies for the company, picks the men to carry out its vast operations and runs a continuous review to insure that their selections do a good job.

Prime qualifications for the job are basic experience and expertness in one or more of the many fields which interest the company. A well-rounded background plus sound judgment and objectivity form the other requirements. In picking a man to fill the job the board of directors, in the words of one board member, "looks for a man whose head is screwed on right."

Recently, the board sifted the organization to find two men who could meet its rigid specifications. First, they reached into the organic chemical dept. and plucked Samuel Lenher, then assistant general manager. A short time later they chose a man from the textile fibers dept., David H. Dawson, also an assistant general manager.

▶ **Advises on Research**—Sam Lenher fills the executive committee post from which Roger Williams (*Chemical Engineering*'s January '55 Man of the Month) recently retired. He'll act as advisor on research, an activity on which Du Pont lavishes $60 million yearly.

Sam studied chemistry at the University of Wisconsin, where his father, Prof. Victor Lenher, taught the subject for nearly 30 years. He graduated with honors at the age of 19. For the next four years he continued his studies, mostly abroad. He took his Ph.D. at the University of London, then accepted a grant to study the photochemistry of gas reaction at the University of Berlin.

While working at the University of California where he held a National Research Council fellowship, Sam decided to trade academic research for the industrial lab. He joined Du Pont in January 1929, in December of the same year he married Iréné Kirkland, a Lake Forest, Ill., girl he had met while studying in London.

▶ **Start in Research**—Sam started with Du Pont as a research chemist at the company's Wilmington Experimental Station. He grew into such assignments as technical manager of the fine chemicals div. and superintendent of the development group at the vast Chambers Works.

In 1944 he was named assistant manager of the Works and the next year, manager.

In October 1946, Du Pont shifted him to its Wilmington headquarters as director of manufacture for the dyestuffs div. Four years later, Sam became assistant general manager of the organic chemicals dept.

▶ **Leader Elsewhere, Too**—In addition to his many duties and responsibilities with Du Pont, Mr. Lenher holds office in several other organizations. He's past president and a director of the Welfare Council of Delaware, a private social agency; president of the University of Delaware Research Foundation, a privately endowed agency; trustee of Town Hill School; and, since last fall, president of the Synthetic Organic Chemical Manufacturers Association, a 92-company organization representing the major organic chemical makers.

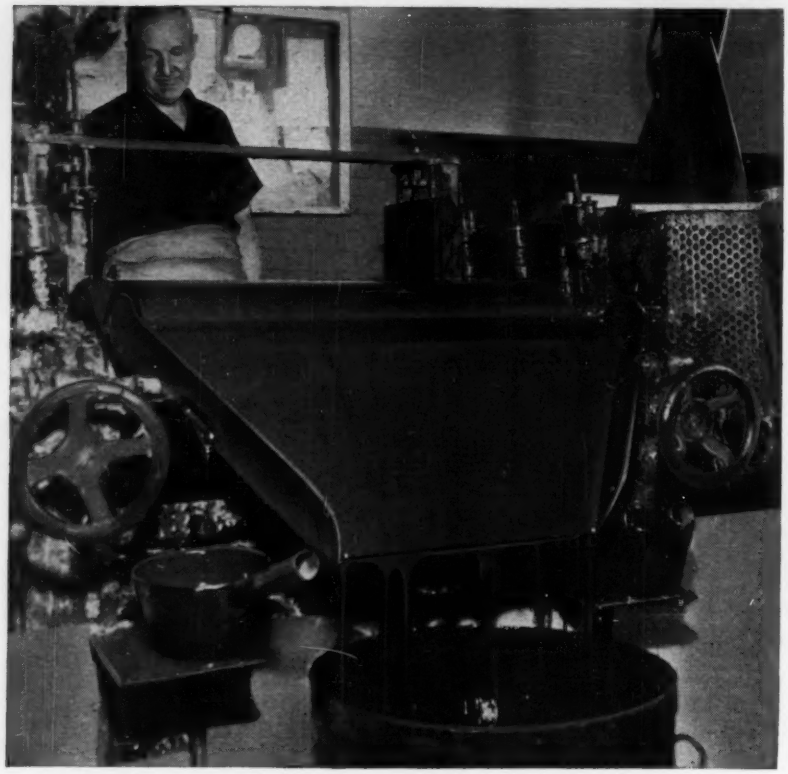
The Lenhers' oldest son, John, 23, is in the air force; daughter Ann, 21, is now at home and son George, 17 is a student.

Over six feet tall and weighing about 180 lb., Lenher likes to spend some of his spare time on the squash and tennis courts.

▶ **Youngest Member**—Dave Dawson, a 46-year old chemical engineer who is now the youngest member of Du Pont's executive committee, is also a spare-time tennis enthusiast—although he lists his chief hobby as "sitting."

Early interest in math and chemistry led him from Philadelphia's Northeast High School to Drexel Institute of Technology in the same city. He took advantage of the school's co-operative plan—three months of study, three months of work in industry—to pile up stock of practical experience by

FIRE HAZARD FOILED!



VINYL RESIN PLASTICIZERS AND VOLATILE SOLVENTS

Wherever highly combustible materials are used – as in this "dope room" at the Athol Manufacturing Company's Massachusetts plant, a potential fire hazard is *always* present!

Athol executives were keenly aware of the importance of *dependable, automatic* fire protection to provide the maximum in safety measures. So Athol called on Kidde – leaders in the field of fire extinguishing equipment.

Kidde engineers analyzed the various hazards, installed a 20-cylinder CO_2 extinguishing system which would automatically snuff out fire the instant it showed itself. In addition, pressure-operated trips were incorporated in the system to shut doors and windows, shut off fans and motors and to sound an alarm.

See to it that every fire hazard in *your* plant – machinery, flammable liquids, electrical equipment – gets the *best* in fire protection. Contact Kidde today!

Kidde (K Kidde) **Walter Kidde & Company, Inc.**
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NAMES . . .

the time he received his BS in chemical engineering in 1930. He also managed time to edit the yearbook, play basketball and run orientation camp for the freshmen.

The following fall Dave went to Ohio State University as a graduate assistant in the chemistry dept. During the 1932-33 school year at Ohio State he held a Du Pont fellowship and in June, 1933, he received his Ph.D in physical chemistry. Much of his research at the university concerned deuterium, before that heavy isotope of hydrogen had even been named.

▶**Start in Pigments**–After getting his Ph.D., Dave applied for a job with Du Pont–only to be turned down. This happened several times– it was mid-depression 1933, remember–before he finally landed with Krebs Pigment and Color Corp., a Du Pont subsidiary, now its pigments dept. At Krebs he went into research on titanium dioxide, a product then beginning to develop.

Between 1934 and '35 he shuttled between the company's Balimore and Newark plants doing patent and administrative work as well as research. Late in '35 he settled in Baltimore, where for the next five years, Dave supervised research on TiO_2, plant development and customer service work. The latter included talks before paint and varnish groups on the properties and uses of TiO_2 in paints and pigments.

In 1940 he shifted his activities to Du Pont's Newport, Del., plant. At the same time exploratory research work titanium metal began. But, before long, World War II commanded a large part of the company's effort and Dave turned to Manhattan District projects.

▶**Gained Experience**–Elevated to assistant director of research on pigment colors in 1944, he left the white pigments to help develop new processes for other coloring agents. Two years later he broadened his administrative background as the department's director of of sales. And in 1948 Dave became assistant general manager of the department, his first experience with over-all management problems

involving production as well as sales and research.

In this post, he faced major problems in process development and production of titanium metal, applying new TiO_2 processes and diversifying product lines. Dawson's contributions to their solution identified him as the possessor of top-notch ability, and in 1951 he was named assistant general manager of the fabrics and finishes dept.

To years later he had an opportunity to gain more experience with production as general director of the manufacturing divisions of the company's textile fibers dept. And just last year he became assistant general manager.

Along with his prime hobby, "sitting," he enjoys music and reading. Dave and his wife, Ann, have three children–Betsy,, 16; Dave, Jr., 14; and Mike, 10. His favorite sport is tennis, and he's pretty good at it, although he feels that it won't be long before Betsy and Dave, Jr., will be able to take his measure.–HTS

William Lee Sims II–Elected president of Colgate-Palmolive Co.

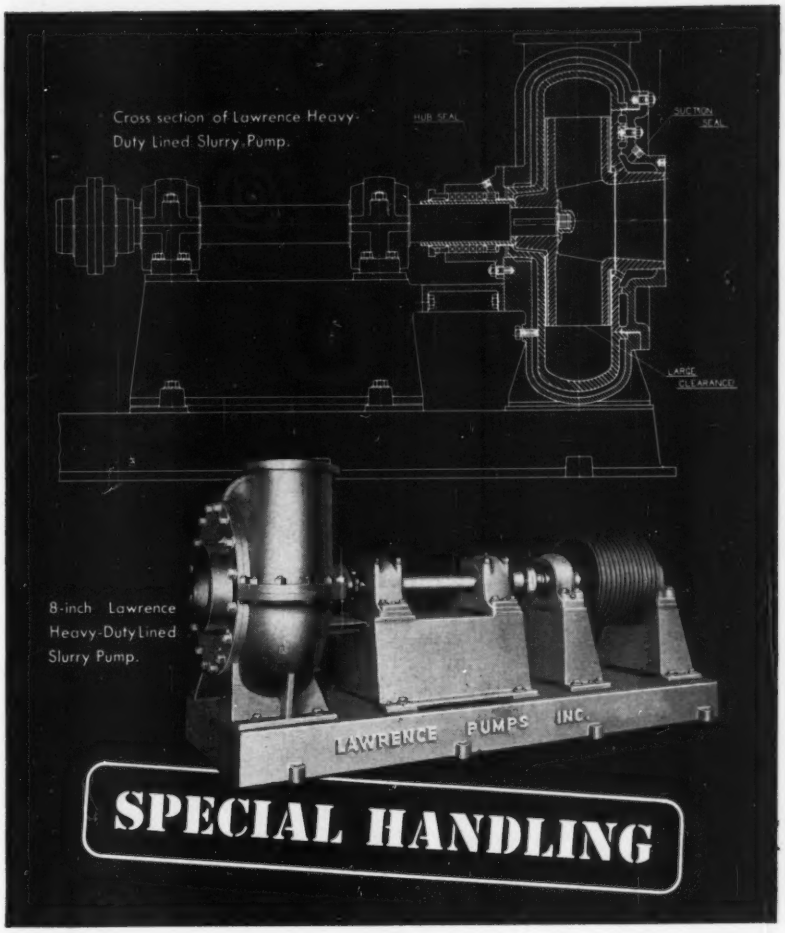
Frank L. Wilhelm–Elected assistant vice president of the Rust Engineering Co., Pittsburgh, Pa.

J. P. Wiseman–Named to head a newly established products company of the Fluor Corp., Ltd. **J. G. Bounds** succeeds Mr. Wiseman as president of the Fluor Corp. of Canada, Ltd.

William B. Porterfield, Jr.–Has joined National Potash Co. as vice president and sales manager.

David Swan–Appointed director of research of Metals Research Laboratories, Electro Metallurgical Co.

J. Boyd Britton–Elected operations vice president of Godfrey L. Cabot, Inc. Mr. Britton will ad-



for heavy abrasive slurries with solids in suspension

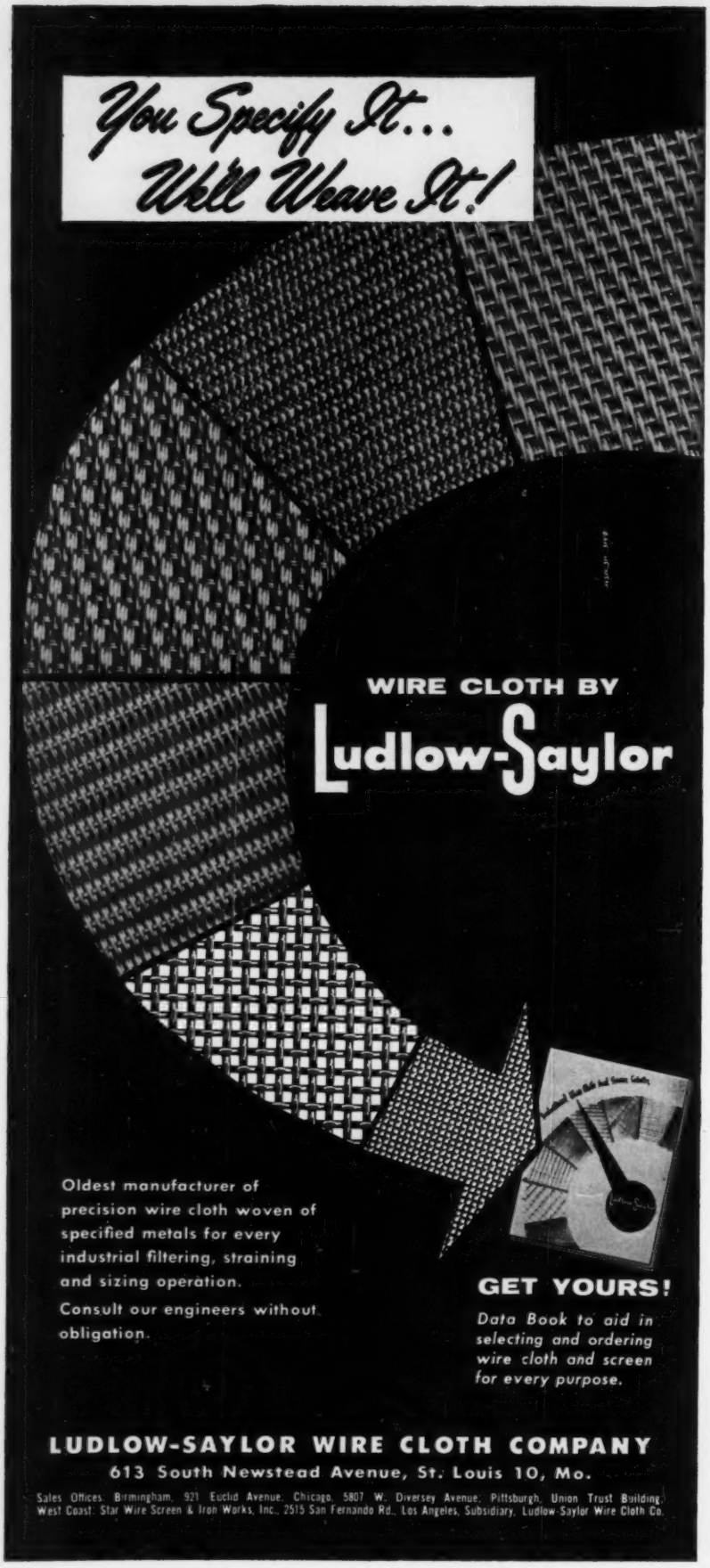
Where abrasive wear is unusually severe or could cause severe damage if the casing wore out, a Lawrence Lined Slurry Pump provides the answer.

The pump is built with a casing liner, disc liner and impeller made of hard, brittle, abrasion-resistant alloy such as manganese steel, Ni-hard, etc. As the casing is designed to withstand full pressure, the liner can be used until actually worn out. Renewal of both the liner and the impeller (if necessary) is very simple because the casing is split horizontally.

The impeller is made with extra large clearances to prevent clogging. Sealing connections are provided on the suction disc and on the hub to flush out any grit or solid matter to prevent wear at these points.

For complete information about Lawrence Slurry and Sludge Pumps write for Bulletin 207-4.

LAWRENCE PUMPS INC.
371 Market Street, Lawrence, Mass.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NAMES . . .

minister and coordinate the work of the research and development personnel and organization, technical service and public relations departments, production planning and control, sales service of the organization.

I. H. Munro

Mr. Munro has been appointed vice president of Solvay Process Division, Allied Chemical & Dye Corp. He joined Solvay's engineering department at Syracuse, N. Y., in 1935, was appointed assistant chief engineer in 1945 and six years later assumed the duties of chief engineer. Mr. Munro was transferred to the New York office and appointed assistant to the executive vice president in 1953. In assuming his new duties, he will continue to be located at the New York executive offices.

Raymond Stevens—Elected honorary chairman of the American Section, Society of Chemical Industry, for the year 1955-1956. Mr. Stevens is senior vice president of Arthur D. Little, Inc.

F. Paul Ronca—Elected chairman of the Technical Committee of the Abrasive Grain Association. Mr. Ronca is manager of the silicon carbide product engineering department of the Carborundum Co.

Ju Chin Chu—Promoted from associate professor to professor of chemical engineering at Polytechnic Institute of Brooklyn.

John E. Hull—Elected president of the Manufacturing Chemists' As-

sociation, Inc. General Hull, U.S.A. (ret.), was former U.S. and UN commander-in-chief in the Far East.

Eric A. Kerbey—Elected president of Midwest Piping Co., Inc., St. Louis, Mo. Mr. Kerbey has, for the last 11 years, been executive vice president of the company. He succeeds **A. G. Stoughton**, who continues as chairman of the board and chairman of the executive committee.

Harold L. Price—Named director of the recently established Division of Application, Atomic Energy Commission.

Francis C. Frary—Awarded the Guido Dengani Gold Medal by the Associazione Italiani di Metallurgia. Dr. Frary was former director of research for Aluminum Co. of America.

Roy MacLean—Appointed general foreman in charge of production at American Lithium Chemicals, Inc., plant, San Antonio, Tex.

Joseph H. Anderer—Named leader of the newly created viscose staple section, research and development division, American Viscose Corp.

H. Zane Schofield—Appointed supervisor of the ceramics section in the ceramics and minerals research department at Armour Research Institute.

B. D. Thomas, David C. Minton, Jr., John S. Crout—Appointed vice presidents of Battelle Institute, Columbus, Ohio.

John W. Shier—Named assistant general manager of Acheson Colloids Co., Port Huron, Mich.

Max Spencer—Named Chattanooga plant production engineer for Central Soya Co., Fort Wayne, Ind.

Henry W. Rahn—Appointed assistant technical director for Columbia-Southern Chemical Corp.

Here's How to Handle Corrosives at High Peripheral Speeds

CHEMLON YARN PACKING STYLE C-30 Made of TEFLON* FIBER BY "JOHN CRANE"

Chemlon Yarn Style C-30 extra tough packing gives you two important advantages not provided by other types of braided or molded Teflon packing: 1) positive sealing efficiency at high peripheral speeds; 2) cooler running stuffing box under severe service conditions.

Style C-30 can be used to handle the most destructive acids, alkalis or solvents. The excellent thermal properties of Teflon, combined with the softness, resiliency and fluid retentive properties of fine fiber construction, adapt it to high temperature conditions to +300°F. The packing is made firm and dense by means of a special process which eliminates *large* voids.

HERE'S PERFORMANCE PROOF:—Fluid handled: 45% H_2SO_4 (impure) at 170°F.—Operating conditions: 1¼" pump shaft at 1700 rpm. or 555 fpm. peripheral speed. Results: 46 days good service. Previous best service record 7 to 10 days.

Chemlon Yarn Packing Style C-30 is available in spool or coil form, in a wide range of sizes from ⅛" up. *Can be lubricated with Teflon suspensoid or various types of lubricants.*

Send for Bulletin No. P-321. Crane Packing Co., 1809 Belle Plaine Avenue, Chicago 13, Illinois.
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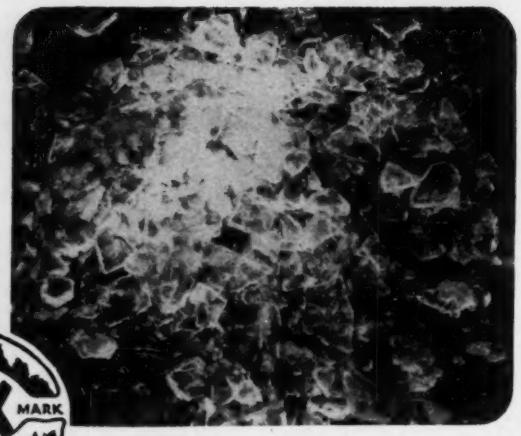

TRADE FRICK MARK

Shell-Ice Maker

If you need broken ice for any purpose—process work, storage, food service, or shipping—the facts about Shell-Ice will pleasantly surprise you.

Shell-Ice is frozen on polished vertical tubes by direct-expansion ammonia or Freon, in thicknesses of ⅛ to ½ inch, and is broken by spinners into odd-sized pieces as small as wanted. No snow, scrapings or waste, and no special cleaning required. Shell-Ice is hard and solid, and with average good water is clear.

The Shell-Ice Maker is quick-acting, highly efficient, automatic and economical. All-steel construction, no delicate parts. Scale does not collect on freezing surfaces. Built in 12 standard sizes, ½ to 30 tons ice-making capacity. Requires very small floor space: Dozens already in satisfactory service.

Get the whole story: ask for Frick Bulletin 54. Write

DEPENDABLE REFRIGERATION SINCE 1882
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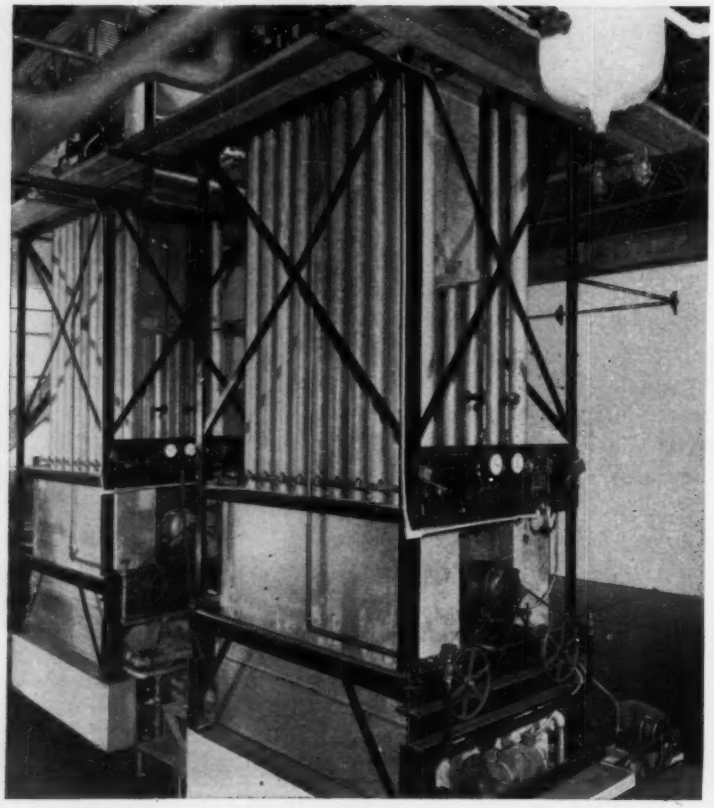
Below: Two Shell-Ice makers, each of 20 ton capacity, in operation.



NAMES . . .

He has been director of research and development at the company's operations at Corpus Christi, Tex., since 1950.

John F. Myers—Joined the Denver Equipment Co. as consultant. He was formerly superintendent of concentration for Tennessee Copper Co.

George A. Cabaniss—Joined the Borden Co.'s chemical division as general manager of its Polyco department plant in Illiopolis, Ill.

Calvin C. Dorough—Appointed to the position of superintendent, fertilizer manufacturing, for the new fertilizer project now under construction by California Spray-Chemical Corp., Richmond, Calif.

Howard J. Davis—Elected to succeed **W. B. Caldwell,** retired, as president of Calumet Steel and Franklin Steel Divisions of Borg-Warner Corp.

T. A. Wilker—Promoted to superintendent of Carbide & Carbon Chemical Co.'s entire plant at Texas City, Tex. **L. L. Dintiman,** formerly vinylite supervisor, succeeds Mr. Wilker as superintendent in charge of vinylite and polyethylene production of the Texas City plant.

Arno C. Fieldner—Retired from the Bureau of Mines, after more than 48 years of service. Dr. Fieldner is dean of government research scientists and internationally known authority on coal and related fuels.

H. Stanley Lawton—Appointed sales manager of container and chemical specialty products for Dewey and Almy Chemical Co.

Paul S. Foster—Named manager of Dow Chemical Co.'s San Francisco office. He was previously chemicals sales supervisor. **R. L. Bryant,** who has been serving as superintendent of transportation for Dow's Texas division, has

been appointed manager of construction for Nederlandsche Dow Maatschappij, N. V. **Edward C. Burdick,** director of Dow's patent department for the past 18 years and widely known in his field as a specialist in chemical patents, has retired after nearly 40 years' service with the company.

Robert G. Picard—Joined Central Scientific Co. as director of research and engineering development.

William L. Loving

Mr. Loving has been elected vice president and manager of the carbon black division of Cabot Carbon Co., a subsidiary of Godfrey L. Cabot, Inc. He was associated with a rubber concern before starting with Cabot as a chemical engineer in 1930. In 1940 he became director of the research and development department, Southwestern division. In 1945 he was promoted to executive assistant to the general manager, carbon black department.

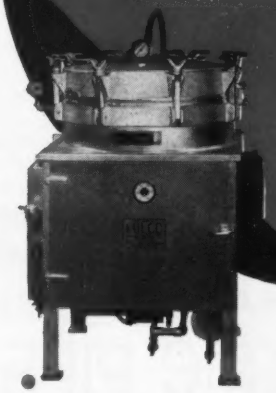
Cornelius C. Coakley—Appointed director of operations of National Aniline Division, Allied Chemical & Dye Corp. **James F. Daly** succeeds Mr. Coakley as manager of National Aniline's Buffalo, N. Y., plant. **Edwin H. Bebee** has been appointed assistant engineering manager of the Division.

Robert M. Busche—Promoted to assistant superintendent in the general products research group of the technical section, Du Pont's plant at Belle, W. Va. **W. Samuel Carpenter, III,** has

HILCO

provides *lower* vacuum pump maintenance costs . . .

increased vacuum-



OIL RECLAIMER

HILCO OIL RECLAIMER

purifies vacuum pump oil by continuous recirculation, either on a full-flow or by-pass basis, or intermittently on a batch basis, depending upon the requirements and physical layout of your plant.

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A simple, economical and efficient method of restoring contaminated lubricating and sealing oil to the full value of new oil. HILCO Oil Reclaimers are used for the purification of vacuum pump oil in conjunction with the manufacture of transformers, condensers, capacitors, drugs, vitamin concentrates, radio tubes and light bulbs, essential oils, optical lenses, refrigeration compressors, titanium and many other products. A HILCO will produce and maintain oil free of all solids, sludge, acid, moisture, solvents, and dissolved gasses and restore viscosity, dielectric strength and other specifications to new oil value.

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These Features!

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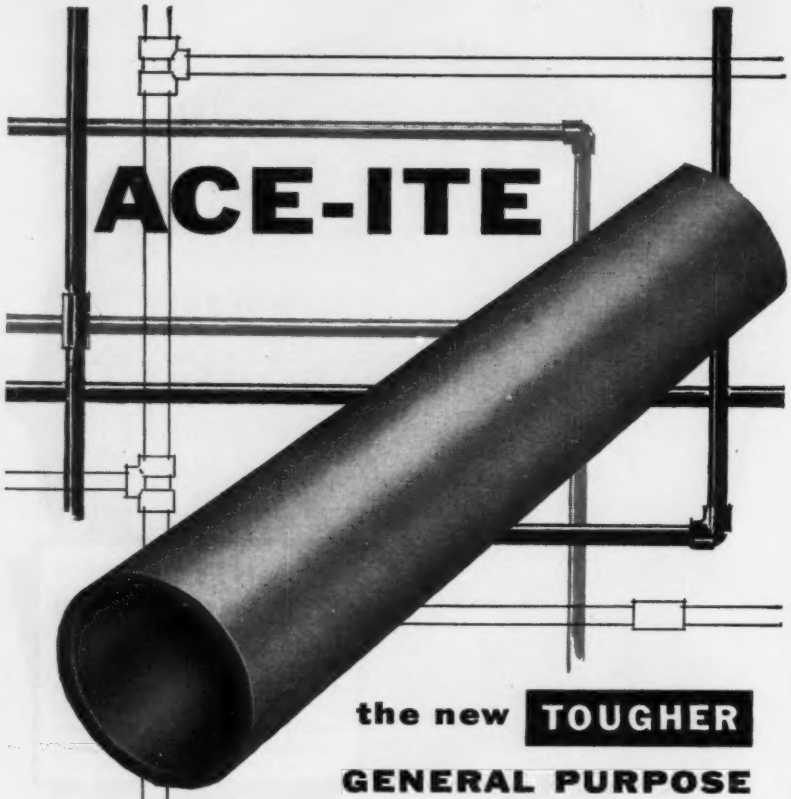

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PLASTIC PIPE

ACE-ITE is a new moderately priced rigid plastic pipe with exceptional impact strength and toughness . . . handles most corrosive fluids in your plant at moderate temperatures and pressures.

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NAMES . . .

been named assistant director of sales of Du Pont's petroleum chemicals division. **John R. Davis,** administrative assistant in the company's elastomers division, has been named technical sales representative assigned to the division's Akron, Ohio, district sales office.

Raymond B. Seymour

Dr. Seymour, formerly president of Atlas Mineral Products Co., has been named president of Loven Chemical Co., Newhall, Calif., manufacturers of plastic materials and sole producers of phenolic molding compounds in the West. A noted chemist and member and officer in leading technical and trade societies, Dr. Seymour has authored or co-authored numerous books and articles. As former president of Atlas Mineral Products and, prior to that, director of special products research for Johnson & Johnson; director of the University of Chattanooga's Industrial Research Institute; group leader in plastics for Monsanto Chemical Co.; research chemist for Goodyear Tire & Rubber Co., he was responsible for developments which resulted in more than 50 patents assigned to these companies. In his new post, Dr. Seymour succeeds Harry Millerburg, who becomes chairman of Loven's board of directors.

Robert M. Lamperouse—Named plant manager of Imperial Sugar Co.'s refinery at Sugar Land, Tex.

Edward G. Kominek—Promoted to position of general sales manager of Infilco Inc.

Russell B. Stoddard—Assigned to the technical staff of Food Machinery and Chemical Corp.'s chemical divisions administrative offices, New York City. **Robert H. F. Dade** succeeds Mr. Stoddard as manager of the company's Fairfield chemical division.

W. E. Breitenbach—Named executive vice president of Alaska Pine & Cellulose Ltd. Mr. Breitenbach was formerly vice president in charge of manufacturing of Rayonier Inc.

Max Schreiner—Named executive engineer of Elliott Co., Jeanette, Pa. He will be responsible for all engineering of the company's turbine, compressor, supercharger and general apparatus divisions.

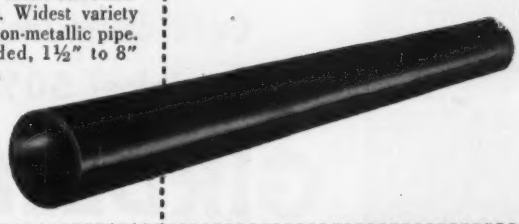
Mahlon G. Milliken—Retired as a vice president and member of the executive committee of Hercules Powder Co. He will remain as a member of the company's board of directors until the end of the year. **Wyly M. Billing** and **John R. L. Johnson, Jr.** have been elected vice presidents of the company. **Henry A. Thouron** succeeds Dr. Billing as general manager of Hercules' synthetics department. **Charles S. Maddock** succeeds Mr. Johnston as director of the company's legal department. **A. M. Ball** has been transferred to Hercules' home office for assignment to special duties including continuation of his present contacts with Defense Department agencies and with ordnance plants operated by Hercules. **Lyman G. Bonner** succeeds Dr. Ball as manager of the company's experiment station explosives research division.

Bernard M. Fisher—Named manager of special chemicals department, Henry Interdonati, Inc., New York City. Mr. Fisher was formerly assistant director of the special chemical division of Winthrop-Stearns, Inc.

C. B. McCord—Named plant manager of International Paper Co.'s

OLDEST PLASTIC PIPE STILL "TOPS"

ACE hard rubber . . . now more than a century old . . . long the finest corrosion-resistant pipe available. Widest variety of fittings of any rigid non-metallic pipe. Sizes ¼" to 8" threaded, 1½" to 8" flanged. *Bulletin CE-51.*



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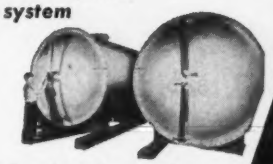

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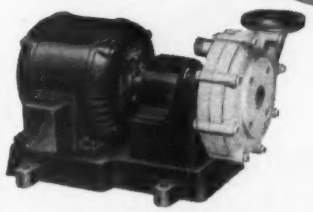

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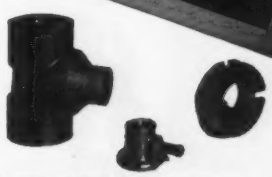
On job after job, this 80-gpm. centrifugal pump has earned highest praise. Hard rubber casing and impeller, Hastelloy C shaft. Handles nearly all corrosives. Mechanically simple, trouble-free. *Bulletin CE-55.* Larger ACE pumps available.



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NAMES . . .

three multiwall bag plants in Camden, Ark., Bastrop, La., Mobile, Ala.

Clinton B. Burnett – Appointed general manager of Johns-Manville Celite division.

J. L. Ober–Reelected president of the University of Maine Pulp and Paper Foundation. Mr. Ober is vice president of Scott Paper Co., Chester, Pa.

George Van Gorder–Elected chairman and president of McKesson & Robbins, Inc.

Bertram K. Denton–Named assistant to the general manager of Monsanto Chemical Co.'s overseas division.

Charles S. Quillen–Appointed sales engineer, New Jersey territory, for Aurora Pump Division, New York Air Brake Co.

Walter E. Brewer–Named manager of Nopco Chemical Co.'s textile chemicals division.

Gale W. Bennett–Appointed a refractories engineer by the Norton Co.

Bradley K. Holbrook–Named project engineer of the Owens-Illinois glass container plant to be constructed in Portland, Ore.

George Brown–Appointed manager of the Paulsboro, N. J., plant of Pennsylvania Salt Mfg. Co.'s I. P. Thomas Division.

William C. Neumann–Named chemical research engineer in the special applications department of the Permutit Co.

Three appointments to fill new positions in Phillips Chemical Co.'s newly created plastics sales division are: **Walter R. Clark,** promoted to assistant sales manager; **R. Vernon Jones**, manager, technical service and development; **R. M. Wallace**, administrative assistant and coordinator of the new division.

E. J. Fox

Mr. Fox has been appointed assistant works manager of Carbide and Carbon Chemicals Co., a Division of Union Carbide and Carbon Corp. He has been with the corporation since 1930, when he joined Carbide and Carbon as a production engineer. He subsequently moved to department head and then chemical area supervisor at South Charleston. Later he became assistant plant superintendent at Texas City, and superintendent of the butadiene plant operated for Rubber Reserve at Louisville, Ky. In 1946, he returned to his former position in Texas City and became plant superintendent in 1952.

Wallace S. Frank – Appointed supervisor-process development unit for General Electric Co.'s silicone products department. **Robert S. Bell** will become manager of the reactor section in the manufacturing department at the Hanford plutonium plant being operated near Richland, Wash., by GE for the AEC.

Richard L. Harvin–Joined the Girdler Co. as a process engineer in the gas processes division.

Robert B. Zimmerli – Appointed sales manager of the Polymer Corp.'s subsidiary, National Polymer Products, Inc. Mr. Zimmerli, before joining Polymer in the early 1950's, was, for five years, development engineer in the polychemicals division of Du Pont.

A. K. Brill–Retired as development manager of Republic Rubber Di-

Rockwell-Built

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Efficient, Inexpensive Protection for Gages, Meters, Regulators, Valves, etc.

Failures or, even worse, errors in your recording and automatic measuring devices caused by grit, scale, and other dirt can be prevented. Install inexpensive Edward steel strainers just ahead of all your delicately adjusted equipment.

Large, rust proof stainless steel screen—effective perforated area up to approximately seven times the internal area of the pipe—insures you free flow and minimum cleaning. Extra fine perforations (.027 inch diameter) stops dirt from damaging small valves, meters, gages regulators, etc.

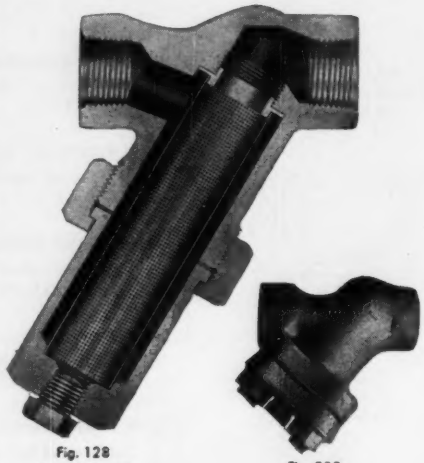

Fig. 128
Sizes ¼" to 1"

Fig. 228
Sizes 1¼" to 2"

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Here's Why EDWARD STRAINERS ARE YOUR BEST STRAINER BUY

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NAMES . . .

vision, Lee Rubber & Tire Corp., Youngstown, Ohio. **J. P. Mathews,** promoted to chief chemist, will assume the duties formerly handled by Mr. Brill.

William L. Dempsey—Resigned as president of the Sharp & Dohme Division of Merck & Co., Inc. John G. Bill, vice president and general manager, will become chief executive officer of the Division.

Russell L. Maycock—Appointed director of Shell Chemical Corp.'s Houston research laboratory, succeeding **John Anderson.** Mr. Anderson has been made director of the new laboratory at the firm's synthetic rubber plant in Torrance, Calif.

W. T. Hack—Named president of Snyder Chemical Corp., Bethel, Conn. Mr. Hack was formerly director of product development for the Ethyl Corp.

Russell G. Dressler—Joined the Southwest Research Institute as manager of chemical engineering research.

Fred L. Shanklin—Appointed vice president and general manager of the ore division of Union Carbide and Carbon Corp.

Ernest E. Lyder—Elected president of the U. S. Oil & Refining Co. Dr. Lyder has been with Standard Oil of Calif. for 26 years, most recently as general manager of its El Segundo refinery.

Daniel W. Elam—Assumed direction of the newly established adhesives engineering division of Hexcel Products, Inc., Oakland, Calif.

Sam R. Bethea—Appointed research specialist in research and development division at Humble Oil & Refining Co.'s Baytown, Tex., refinery.

H. Wayne Hilton—Named to head a new department of organic chemistry research at the Ha-

waiian Sugar Planters' Assn. experiment station.

OBITUARIES

Harold Everett Hall, president of Metals Disintegrating Co., Inc., subsidiary of American-Marietta Co., died at his summer home in Short Hills, N. J., on July 8. Mr. Hall was 45 years old.

Michael J. Wynn, 56, manager of the American Can Co.'s Hudson plant, Jersey City, N. J., died July 13.

Helen Stratton, 62, secretary-treasurer of the Packaging Machinery Manufacturers Institute, died July 26 in New York City.

George William Lucas, 46, supervisor of carbide materials and processing engineering, Carboloy department of General Electric Co., Detroit, died suddenly July 28.

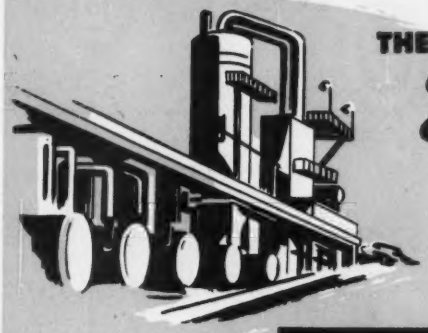
Richard Samuel Reynolds, founder and chairman of the board of Reynolds Metals Co., died on July 29, at his home in Richmond Va., at the age of 73.

Bernard W. "Marc" Anthony, secretary and treasurer of Oronite Chemical Co., San Francisco, died August 3 in Lafayette, Calif.

Gerald F. Alcorn, construction engineer for the pulp division of Weyerhaeuser Timber Co., died August 5 at Tacoma, Wash.

Francis B. Blackstone, 48, superintendent of the Louisiana power plants of the Freeport Sulphur Co., died August 7 at Houma, La.

William J. Hale, 79, Dow Chemical Co. research consultant and one of the nation's top organic chemists, died August 8 after a brief illness. Dr. Hale was known as the "Father of Chemurgy," a word he coined to describe the putting of chemistry and related sciences to work in industry for the farmer.



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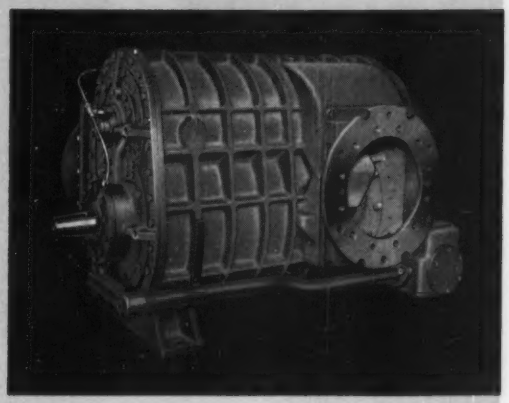

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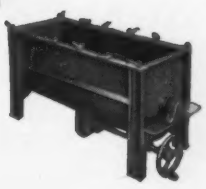

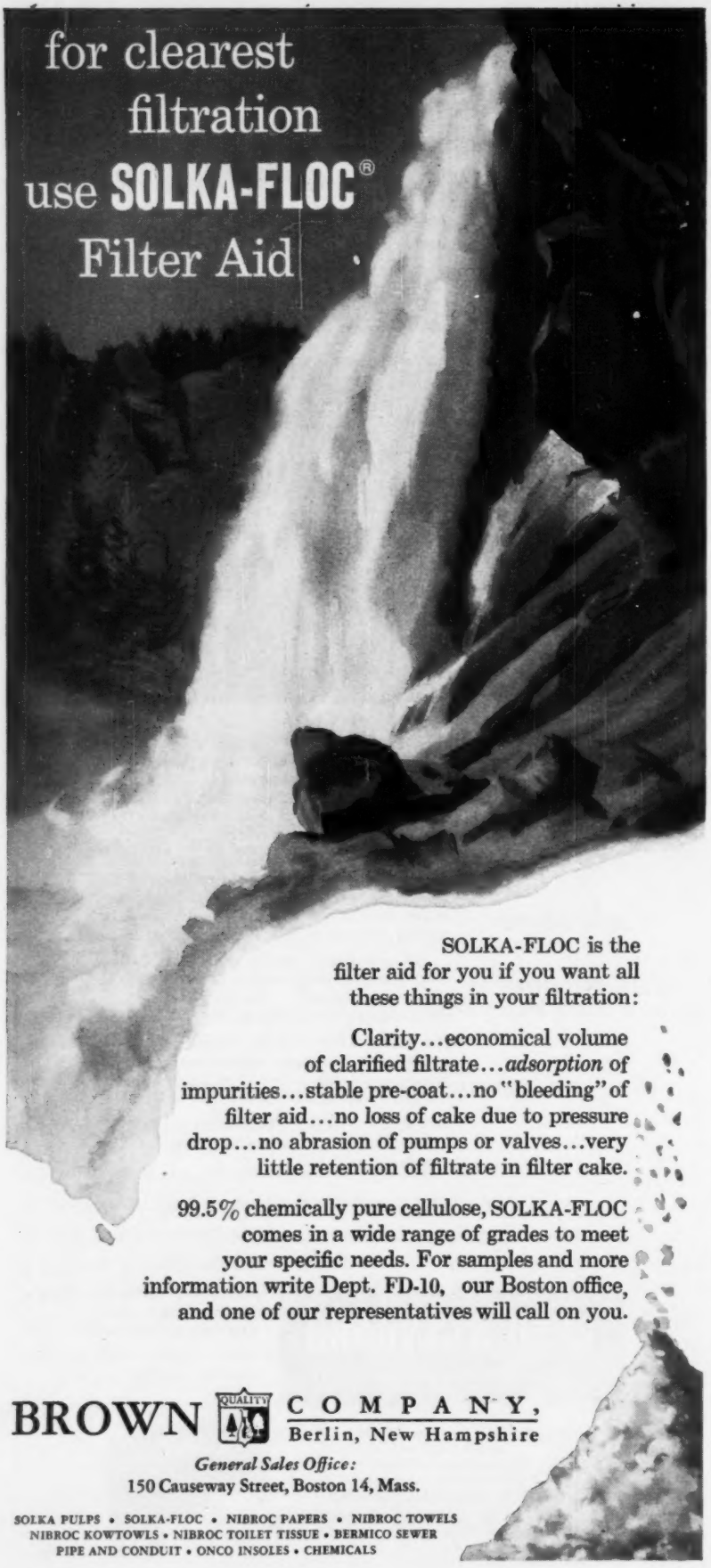
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THIS MONTH'S

Technical

Beg, Borrow or Shun

COORDINATION, CONTROL, AND FINANCING OF INDUSTRIAL RESEARCH. King's Crown Press, Columbia University. New York. 429 pages. $8.50.

Reviewed by Roger Williams, Jr.

This book is a collection of papers, most of which were given at the Fifth Annual Conference on Industrial Research in June, 1954. Unfortunately, as is almost always true of collections of talks regardless of editorial skill, the papers are uncoordinated. In this case it is particularly true because of the professed purpose of the publishers "for the purpose of making scholarly material available at minimum cost." The book is done by offset printing from typed copy, presumably to save money. If one multiplies the number of readers—mostly research directors in the $15,000+ category—times the time spent reading it, the savings, if any, disappear. There is no question about it; this book is difficult to read. (Parenthetically, I should comment that it was read during a week in August when the temperature hardly dipped below 90 F.) Another badly missing feature is graphs.

Be that as it may, the book has real value to the research director—and frankly to any young researcher who hopes to be a research director in the future. He will learn one thing from the book at least—that although research employs scientists it is not a science itself. The amount of groping for footholds admitted by research directors of some of America's biggest companies is a bit surprising, especially to a person who has been subjected to big company research most of his life. There tends to be an attempt to find "formulas" for things like research budgets. The participants spent hours worrying why one man's formula did not agree with another's. Such things will

Bookshelf

L. B. Pope

certainly amaze and worry the young chemist or chemical engineer who reads the book.

On the other hand there is plenty of hard meat in this book. The above has been mostly critical. The book, however, contains real merit in many of its printed talks—and luckily a large number of them are by persons in chemical firms. The best thing about the book is that it prints the text of the questions and answers in the discussions after most of the papers. Frankly, these are much more revealing and educational than the papers themselves.

My opinion:

- If you are in research management, buy the book and read it from cover to cover. The ideas you get will be worth the time, cost, and effort (provided you don't read it when the temperature is 90+ F.).
- If you are a young chemical engineer in research, borrow it from your company library and glance through it. A few talks by people in the chemical industry will be worth reading. You will be in a better position to recognize some of the problems your boss faces—and how many of them there are.
- If you have no connection with research, but merely an academic interest in it, figure this book as a marginal proposition. It will probably be terribly boring, if you ever finish it at all.

Recommended for Beginners

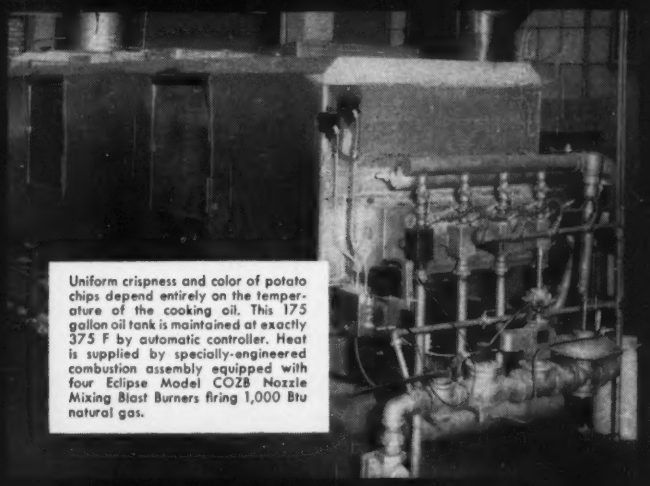
POLAROGRAPHIC TECHNIQUES. By Louis Meites. Interscience Publishers, Inc., New York. 317 pages. $6.

Reviewed by F. C. Nachod

Dr. Meites' book is an outgrowth of a laboratory manual on the experimental techniques of polarography which he used in his courses. To present a well rounded picture he has added to it sections on instrumentation and theory.

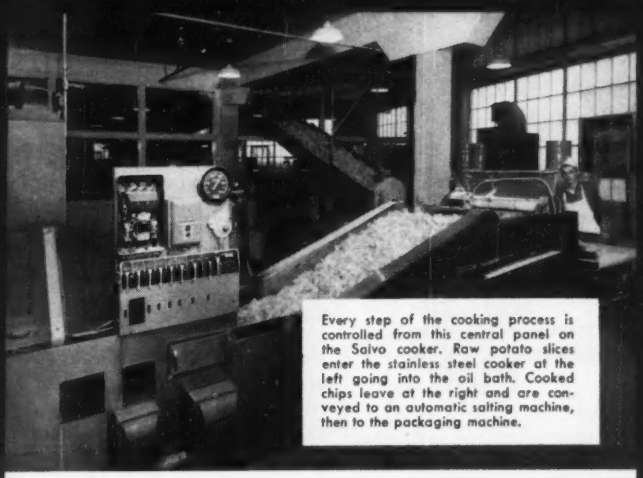
This is not a comprehensive text

Eclipse "Process Designed" Combustion Equipment



Uniform crispness and color of potato chips depend entirely on the temperature of the cooking oil. This 175 gallon oil tank is maintained at exactly 375 F by automatic controller. Heat is supplied by specially-engineered combustion assembly equipped with four Eclipse Model COZB Nozzle Mixing Blast Burners firing 1,000 Btu natural gas.

fires recirculating-oil potato chip cooker



Every step of the cooking process is controlled from this central panel on the Salvo cooker. Raw potato slices enter the stainless steel cooker at the left going into the oil bath. Cooked chips leave at the right and are conveyed to an automatic salting machine, then to the packaging machine.

"Process designed" with the job in mind is a brief description of the Eclipse combustion assembly which fires this Salvo stainless steel recirculating-oil bath cooker. Blue Star Foods, Inc., Rockford, Ill., processes 3,000 lb of potatoes every hour, 16 hours a day, with this equipment.

Precise control of cooking oil temperature is essential in producing crisp, well-cooked potato chips of an appetizing color. This led Salvo Machinery Co. to consult with Eclipse combustion engineers for a special assembly which would meet their needs. Eclipse engineers solved this problem by drawing on their extensive background of combustion experience and selecting the correct equipment from a broad line which can fill almost any process heating requirement.

ECLIPSE FUEL ENGINEERING CO., 1121 Buchanan Street, Rockford, Illinois
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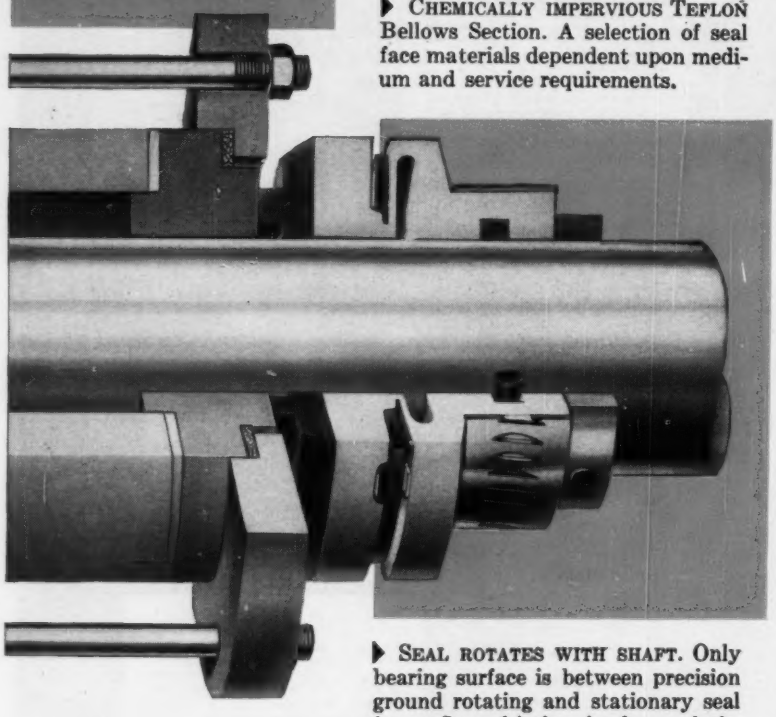
The ideal Mechanical Seal that has no equal in handling acids, alkalies, solvents, hydrocarbons, alcohols—clear liquids, slurries and tarry materials.

FEATURES

- **CHEMICALLY IMPERVIOUS TEFLON Bellows Section. A selection of seal face materials dependent upon medium and service requirements.**



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like Dr. Kolthoff's standard compendium, nor is it intended to be. It is a streamlined introduction in a technique which has proved extremely fruitful and rewarding and it can be warmly recommended to the beginner, be he a student or a bench chemist.

Tribute to Adams

THE ROGER ADAMS SYMPOSIUM. John Wiley & Sons, New York. 140 pages. $3.75.

Reviewed by F. C. Nachod

Here is a "Festschrift" on the occasion of Dr. Adams' retirement as head of the chemistry department at the University of Illinois. Six noted graduate students, one of them a Nobel prize winner, pay tribute to their former thesis professor.

Dr. Volwiler briefly reviews the biography and Drs. W. R. Brode, J. R. Johnson, S. M. McElvain, R. L. Shriner and W. M. Stanley contribute informative reviews of their respective fields in which they have achieved fame and dis tinction.

There is no connecting link between such divergent topics as stereochemistry of dyes, organic structural research and viruses, save for the spark of a beloved teacher who inspired, guided and produced outstanding leaders in science who pay their homage.

Mainly for Chemists

ORGANIC SOLVENTS, PHYSICAL PROPERTIES AND METHODS OF PURIFICATION. (Vol. VII of Technique of Organic Chemistry.) Second edition. By J. A. Riddick and E. E. Toops, Jr. Interscience Publishers, New York. 552 pages. $8.50.

Reviewed by C. L. Mantell

This is a volume directed to the organic chemist and particularly those engaged in synthesis research. It is a collection of physical constants and methods of purification

for solvents. It aims to make readily accessible the abundant material in the literature on this subject. Classification is based on hydrocarbons, compounds with one type of characteristic group, and compounds with more than one type of characteristic group, with subdivisions thereof. After a discussion of physical properties and criteria for the selection of solvents having specific physical properties, there are tabulations of the solvents and their properties, particularly those of interest to the organic chemist. The latter half of the book concerns criteria of purity, the purification methods, with a concluding section in bibliography.

Essentially the volume serves a need of the research organic chemist, but is only of indirect interest to the engineer or the tonnage user of solvents in the sense commonly employed. The volume adds another well edited, carefully compiled source book of data on solvents specifically in reference to their purified forms.

Recent Books Received

Catalysis. Vol 3. Hydrogenation and Dehydrogenation. Ed. by P. H. Emmett. Reinhold. $12.

Chemical Engineering Cost Estimation. By R. S. Aries and R. D. Newton. McGraw-Hill. $6.

Dictionary of Mechanical Engineering Terms, 7th ed. By J. G. Horner. Philosophical Library. $6.50.

Electronic Data Processing in Industry. American Management Assn. $7.75.

Electro-Technology. By M. G. Say. Philosophical Library. $6.

Introductory Laboratory Course in Chemistry. By Howard L. Ritter. Wiley. $2.50.

Laplace Transforms for Electrical Engineers. By B. J. Starkey. Philosophical Library. $10.

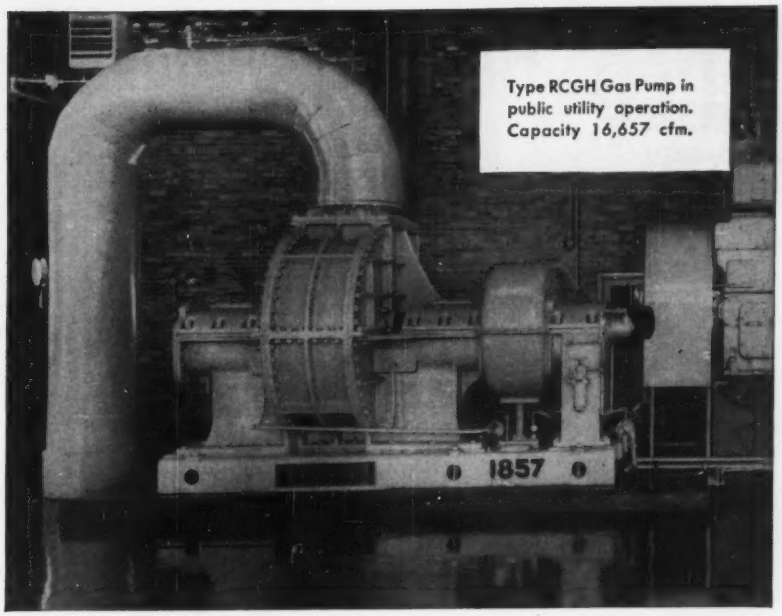
Metallurgy of Zirconium. Ed. by B. Lustman and F. H. Kerze, Jr. McGraw-Hill. $10.

New Methods in Analytical Chemistry. By R. Belcher and C. L. Wilson. Reinhold. $5.50.

Principles of Nuclear Reactor Engineering. By Samuel Glasstone. Van Nostrand. $7.95.

Process Engineering Economics. By H. E. Schweyer. McGraw-Hill. $7.50.

Production of Heavy Water. Ed. by G. M. Murphy. McGraw-Hill. $5.25.



PERFORMANCE OF R-C GAS PUMPS ASSURED BY "BIG 4" ESSENTIALS

CHECK THE "BIG 4" ESSENTIALS

1. *Positive flow*—because of positive displacement principle maintaining the quantity of delivery
2. *Pressure*—controlled to your requirements
3. *Capacity*—always up to ratings, with moderate short time overloads
4. *Economy*—in first cost, power and low maintenance

You may find it profitable to compare your present gas pump performance with R-C proved economy and reliability.

For delivering or exhausting gas in industrial operations, R-C Gas Pumps and Exhausters, in either the Rotary Positive or Centrifugal types, have long demonstrated their complete reliability, efficiency and economy.

For many years, they have been the choice of plant engineers and of leading builders of industrial equipment, where the movement of gas is an essential part of the process.

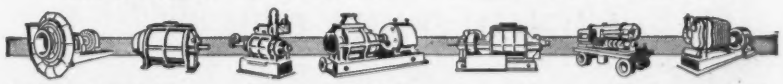
Capacities from 5 cfm to 50,000 cfm at moderate pressures offer close selections for specific needs . . . and further economies are gained from compactness, reducing space requirements and installation costs.

For any present or future project requiring gas pumps or exhausters, ask us for details on R-C equipment, and for help in planning your installations.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
1055 Illinois Ave. • Connersville, Indiana

Roots-Connersville Blower (Canada) Ltd. • 629 Adelaide St. W., Toronto, Ont.



Centrifugal and Rotary Positive Blowers and Exhausters • Positive Displacement Meters • Vacuum Pumps • Gas Pumps • Inert Gas Generators • Spiroaxial Compressors

an ACCO product

Helicoid Gages

For day-in, day-out Sustained Accuracy —for the life of the gage— HELICOID Quality costs you less!

• It's the basic design of HELICOID Gages that makes them outlast and out-perform ordinary gear-tooth gages. This enduring accuracy is evidenced by the smooth rotation of simple spiral roller and cam.

If you use gages it will pay you to investigate HELICOID performance records. There is a HELICOID long-life gage to meet every type of pressure indicating requirement. Ranges are to 20,000 p.s.i. and vacuum or compound.

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Dials may be black, white or radiant.

Wall or stem mounting cases—flush panel or flangeless cases.

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Pressure • Vacuum • Compound

THIS MONTH'S

Recent Books

Electronics in Business

Annotated bibliography covers writings, speeches and visual presentations. Gives essential facts about existent electronic data processing systems, lists installations in use according to company and includes a directory of commercial digital electronic computer centers whose facilities are available on a commercial fee basis. 174 pages.

"Electronics in Business." Controllership Foundation, 2 Park Ave., New York 16, N. Y. $2.

Microscopy

The latest data available in Europe today on the use of microscopy in such areas as chemicals, minerals, ores and metals, coal and coke, wood, paper, and textiles have been compiled in this eight-volume set. A typical volume, No. 4 on silicates, contains 850 pages with more than 400 original micro pictures, many of them in color. Available only in German.

"The Handbook of Microscopy in Technology." By Hugo Freund. E. Leitz, Inc., 468 Fourth Ave., New York 16, N. Y. $30 to $40 per volume.

Radioactive Materials

Informative text concerns fire-safe practice for laboratories handling radioactive materials. Recommendations are directed both to the fire-protection specialist and to designers and operators of laboratories. Text, available in pamphlet form, will also be included in the 1955 edition of National Fire Codes. 41 pages.

"Recommended Safe Practice for Laboratories Handling Radioactive Materials." National Fire Protection Assn., 60 Batterymarch St., Boston, Mass. 50¢.

Cooling Towers

Recommended industrial standards for manufacturers and purchasers of water cooling towers are

& Pamphlets

described in three separate bulletins. The first (5 pages) covers, in detail, a basic procedure for testing water-cooling capability of any industrial tower. The second (3 pages) recommends special grades of redwood lumber for tower use. The third (2 pages) describes design stress allowables for certain grades of lumber.

CTI bulletin ATP-105, "CTI Acceptance Test Procedure." 50¢. CTI bulletin STD-101, "CTI Grades of Redwood Lumber." 25¢. CTI bulletin STD-102, "Structural Design Data." 25¢. Cooling Tower Institute, 444 Emerson St., Palo Alto, Calif.

Ignition

Here is the final volume, No. 4, reporting on a series of experiments conducted by the Naval Research Laboratory to achieve a better understanding of the relationship between fuel composition and ignition properties, and to develop a simple method of testing small quantities of fuels, additives, pure hydrocarbons and other compounds. 15 pages.

"Relation of Minimum Ignition Point to Other Ignition Phenomena." Office of Technical Services, Department of Commerce, Washington 25, D. C. 50¢.

Technical Societies

Unlike previous editions, this listing of technical societies confines itself to membership group organizations. In addition to name, address and officers, each of the entries (1,506 for the U. S. and 206 for Canada) furnishes information on the organization's history, purpose, membership, frequency of meetings and special facilities. 447 pages.

"Scientific and Technical Societies of the United States and Canada." Sixth edition. National Academy of Sciences, National Research Council, Washington 25, D. C.

FOR LOW COST HANDLING AND CRUSHING of ★ROCK ★ORE ★SLAG ★MINE REFUSE ★LIMESTONE ★GYPSUM and other materials

McLANAHAN Heavy Duty RECIPROCATING PLATE FEEDER

Built to handle materials from the size of sand to shovel-loaded rock. Rate of material flow automatically controlled. Quickly adapted to production capacity of any machine.

A combination of McLanahan Reciprocating Plate Feeder and Rockmaster Crusher is your answer to the most economical feeding and crushing of large tonnages of rock, ore, limestone, and other materials. Furnished as separate units or in combination as required.

McLANAHAN Single Roll ROCKMASTER CRUSHER

Here is the economical solution to the most rugged crushing applications involving primary or (secondary) reduction of shovel-loaded rock and ore. Special features include —high capacity, low headroom and many other distinct advantages.

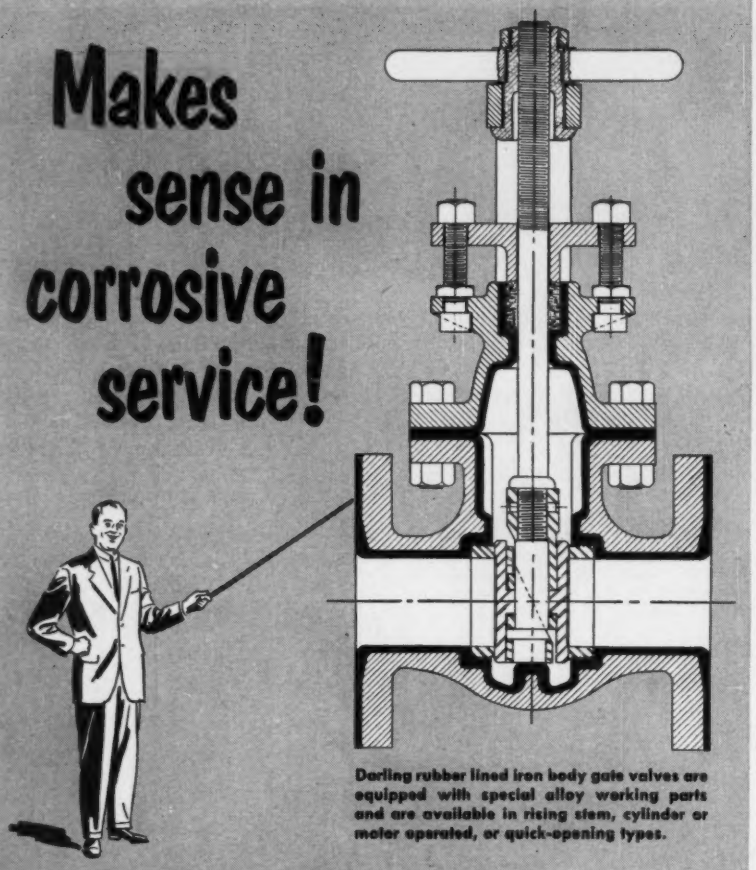
Write Today For Bulletins RM-505 and FRE-4812

McLANAHAN & STONE CORPORATION

PIT, MINE AND QUARRY EQUIPMENT HEADQUARTERS SINCE 1835

254 Wall Street, Hollidaysburg, Pennsylvania

Makes sense in corrosive service!



Darling rubber lined iron body gate valves are equipped with special alloy working parts and are available in rising stem, cylinder or motor operated, or quick-opening types.

DARLING RUBBER LINED IRON BODY GATE VALVES

Problem: How to get away from costly, special alloy gate valves in handling corrosive fluids and still have long, trouble-free valve life.

Answer: For pressures up to 150 pounds and temperatures to 180° use Darling iron body gate valves with the permanently bonded hard rubber lining. They're giving outstanding service in job after job. Moreover, they have the Darling *fully revolving double disc parallel seat feature* that multiplies disc and seat life and assures tight closure longer . . . much longer!

Write for complete information on these exceptional rubber lined valves . . . or for data on other Darling gate valves including the range of alloys, types and constructions for ordinary or special services.

DARLING VALVE & MANUFACTURING CO.
Williamsport 3, Pa.
Manufactured in Canada by
Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING
DARLING
VALVES

THIS MONTH'S

Firms in

New Companies

Vulcan Containers Inc. has been formed by consolidating Vulcan Stamping and Mfg. Co. and Vulcan Tin Can Co.

Recently formed **Hammer Electronics Co., Inc.,** Princeton, N. J., represents an association of Princeton physicists, chemists, engineers and physicians organized to develop, manufacture and market advanced-design instruments for research, testing, medical and industrial applications.

New Lines

Vulcan Steel Container Co., Birmingham, Ala., has just completed installation of an additional steel pail production line which includes modern new paint and lacquer spray equipment and large modern baking ovens.

Pittsburgh Coke & Chemical Co. has announced the addition of specialty tars, coal tar pitch and creosote to the list of products previously manufactured and sold by its protective coating division.

Berry Asphalt Co., Magnolia, Ark., has developed a new complete line of rubberized asphalts for roof coatings, waterproofing, corrosion prevention, highway surfacing and joint sealing.

New Representatives

Vanton Pump & Equipment Corp. has appointed two new sales representatives. Backus & Spencer, Cleveland, will handle the Northern Ohio territory; D. B. Gooch Associates, Birmingham, Ala., will cover Mississippi, Alabama, Tennessee, Florida and Georgia.

Copes-Vulcan Div. of Continental Foundry & Machine Co. has appointed Dickey Engineering,

the News

M. A. Gibbons

Knoxville, Tenn., as representatives for the division's products, including new boiler controls.

Brown-Allen Chemicals, Inc., Staten Island, N. Y. has appointed Maston-Wright Corp., New Haven, as its exclusive export managers.

J. F. Pritchard & Co. of Calif., division of J. F. Pritchard & Co., manufacturer of cooling towers and Hydryers, has appointed two new sales agents: Cone and Wallace Co., Phoenix, Ariz., and Tate Engineering & Supply Co., Inc., Baltimore, Md.

U. S. Industrial Chemicals Co. has named Demert & Dougherty, Inc., Chicago, as exclusive distributor for PiB, the company's liquid insulation.

De Laval Steam Turbine Co. has appointed L. Henriques & Cia., Guayaquil, Ecuador, as its exclusive representative in Ecuador.

Omni Products Corp., New York, N. Y. has been named exclusive overseas agent for Lunn Laminates, Inc.

Foxboro Co.'s full line of instruments will soon be available in Asia through Yokogawa Electric Works, Ltd., Tokyo, Japan.

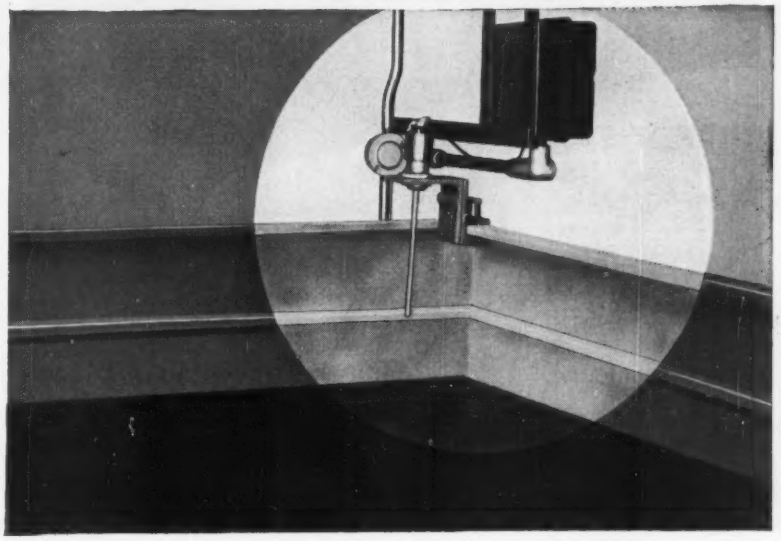
Tenney Engineering, Inc., has named Lee Mark Associates, Kansas City, Mo., to handle sales of environmental test equipment in Kansas and Missouri.

Bee Chemical Co. has taken over the sales of Premier Thermo-Plastics Co.'s line of vinyl extrusion and injection molding compounds.

New Names

American Wheelabrator & Equipment Corp. has changed its corporate name to Wheelabrator Corp.

TEKTOR Keeps Hershey Chocolate from Overflowing Open Tank

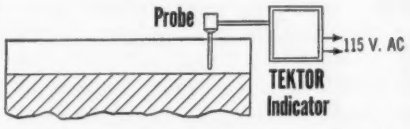


How to keep a 90,000 pound open milk chocolate storage tank from overflowing was the problem faced by the Hershey Chocolate Corporation.

Hershey Engineers found a solution by installing a Fielden TEKTOR High-Level Indicator Controller and Probe. Now, when chocolate level rises to 4 or 5 inches from the tank lip, this simple but dependable instrument flashes and sounds a warning so that the inflow of chocolate can be stopped.

Why TEKTOR Level Control is YOUR Solution

- Indicates or controls level of fluids, powders, solids (conducting or non-conducting)
- Electronically controls level as close as 1/16"
- A ready-to-install unit
- No moving parts . . . only one radio tube
- Regular plant personnel can maintain it
- Low first cost . . . low operating cost.



A TEKTOR probe is installed vertically and its electrical capacity changes when chocolate level is 4 or 5 inches from the lip of the tank. This de-energizes the Indicator relay and switches on the warning light and alarm.

Robertshaw-Fulton CONTROLS COMPANY

Send this coupon today, and find out how Fielden Simplified Instrumentation can solve your process control problems . . . accurately and economically.

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2920 N. Fourth St., Dept. H, Philadelphia 33, Pa.
Please send me bulletins about your low-cost, accurate controls.

☐ TEKTOR Level Control
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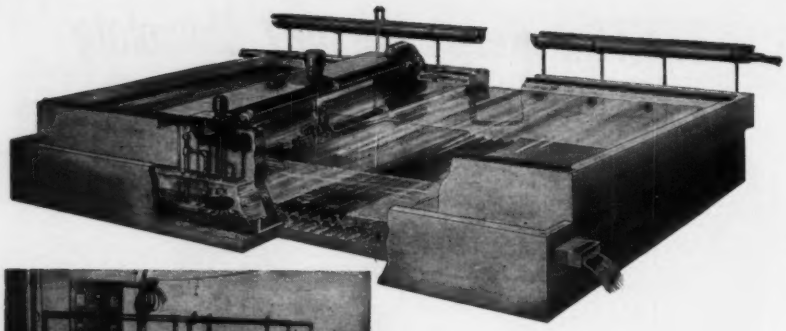
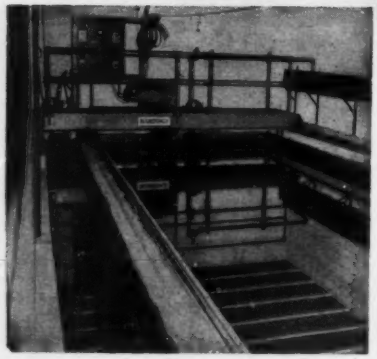
NAME_____ TITLE_____
COMPANY_____ ADDRESS_____
CITY_____ STATE_____





12½′ x 40′ Hardinge Automatic Backwash Sand Filter in a municipal water plant in Vermont. . . . .

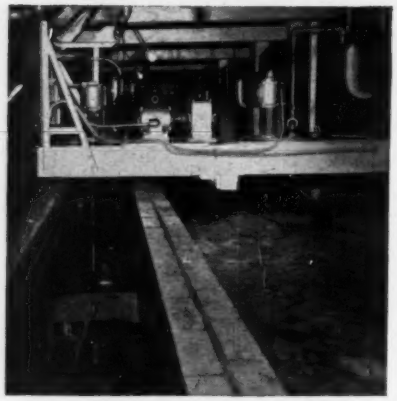
A sand filter which **CLEANS ITSELF**

The Hardinge Automatic Backwash Sand Filter is a complete departure from standard filtration equipment, in that it backwashes its filter bed automatically without interrupting normal filtration.

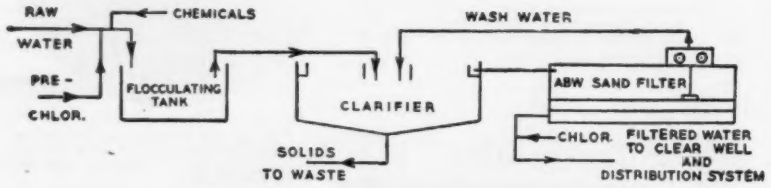
The ABW filter in combination with flocculation and sedimentation equipment provides treated and filtered water for municipal and industrial water supplies.

The filter may be applied also for the treating of plant waste water, for reuse or disposal.

Complete specifications upon request. Bulletin 46-A-11.



6′ x 52′ Hardinge ABW Filter handling supply water in a Canadian paper mill.



Typical industrial water supply flow diagram.

HARDINGE
COMPANY, INCORPORATED

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New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

FIRMS . . .

Ac'cent International is the new name of the Amino products division of International Minerals & Chemical Corp.

NEW LOCATIONS

Jefferson Chemicals Co., Inc. has transferred its executive offices and sales headquarters from New York City to Houston, Tex.

Imperial Chemical Industries (N. Y.), Ltd. has moved its executive offices from 521 Fifth Ave. to 488 Madison Ave. in New York City.

Sales headquarters of the packing division of **Raybestos-Manhattan, Inc.,** has been moved from Manheim, Pa., to Passaic, N. J.

Eastern branch office of **Hyland Laboratories,** Los Angeles, has moved from South Broadway to Hawthorne Ave. in Yonkers, N. Y.

Wolverine Tube has opened new general sales offices in the Guardian Building, Detroit, Mich.

Synthane Corp., Oaks, Pa., has moved its Rochester, N. Y., sales offices from the Genesee Valley Trust Building to West Commercial St., East Rochester, N. Y.

George Black Co., industrial public relations and management counsel, has opened new offices in Union, N. J.

Executive headquarters of **Deep Rock Oil Co.** will be consolidated in the Kerr-McGee building, Tulsa, Okla., within the next five months.

St. Regis Paper Co.'s Panelyte division has established two new sales offices in St. Louis, Mo., and Los Angeles.

Richardson Scale Co. has opened its new European headquarters at Geneva, Switzerland.

Perkin-Elmer Corp. has opened a new regional sales office to serve

the Western and Northwestern states in Pasadena, Calif.

Office of Scientific Research, which has been located at the Air Research and Development Command Headquarters (Baltimore, Md.) since 1952, will be set up as a separate activity and relocated in the Washington, D. C., area.

Inductotherm Corp., manufacturer of high-frequency heating and melting equipment, has moved from Glenolden, Pa., to Delanco, N. J.

Chemical department of **McKesson & Robbins, Inc.** has established new branch offices in Buffalo, N. Y., and Pittsburgh, Pa.

Headquarters staff of **Diamond Black Leaf Co.** has been transferred from Richmond, Va., to Cleveland, Ohio.

W. W. Sly Mfg. Co., Cleveland, has opened a new branch in Los Angeles.

High Voltage Engineering Corp., manufacturer of particle accelerators ("atom smashers") has established a West Coast office in Berkeley, Calif.

Burns and Roe, Inc., engineers and constructors, have created an industrial division which will be headquartered in Baltimore, Md.

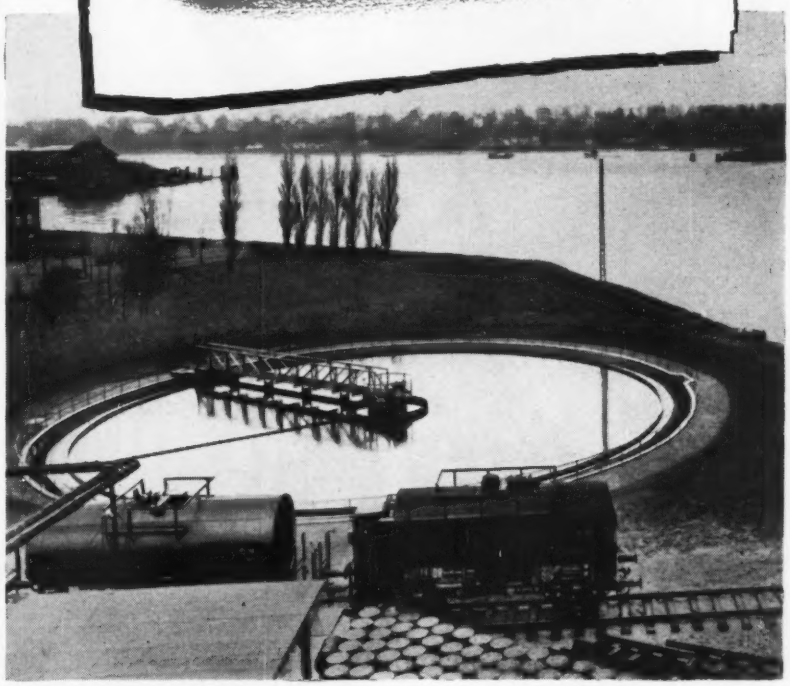
New Facilities

Atomic Energy Commission has awarded a $349,560 contract to **Foster Wheeler Corp.** for the design, construction and test operation of a research reactor at the Livermore Research Laboratory, Livermore, Calif.

General Tire & Rubber Co. has purchased RKO Radio Pictures, Inc., from Howard Hughes for $25 million cash.

Becco Chemical Division of Food Machinery & Chemical Corp. has awarded contracts for con-

Oil Refinery Waste Treatment in Germany



In Germany too, stream pollution by industrial wastes causes serious problems. A large refinery in Hamburg solved the problem with the installation above. Showing a marked similarity to current practice in the United States, the plant employs a 110′ dia. Dorr Clarifier equipped with a skimming arm as the main treatment unit.

Feed to the unit is 6600 GPM of refining waste, and an effluent is produced containing less than 20 ppm of oil, well under the limits required by the authorities. Equipment was supplied by our Associated Company in Germany, Dorr-Oliver G.m.b.H.

If you have a problem involving the separation of finely divided solids in suspension . . . or ion-exchange . . . or the use of fluidizing techniques, there's a good chance that Dorr-Oliver and its world-wide organization can help you.

DORR-OLIVER INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
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PROCESS EQUIPMENT

AN *Experienced*

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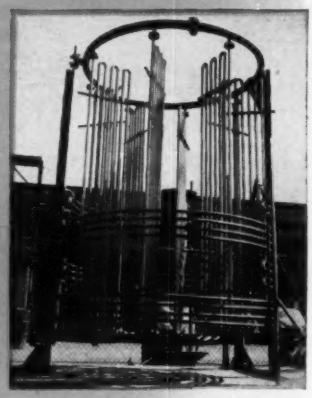

Distillation units of all types, absorbers, condensers, extractors, evaporators, heat exchangers, scrubbers, towers, tanks, process piping, bubble trays and caps, packless expansion joints, etc.... this is the kind of process equipment which we are well-staffed to design and fabricate. Our engineers are familiar with the many processing problems confronting the equipment designer. Our shop has fabricated such equipment for many years, working with all the commercially available metals.

Engineering and Manufacturing

Process Equipment of Our Design to Solve Your Problem

BADGER MANUFACTURING COMPANY

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FIRMS . . .

struction of additions to its hydrogen peroxide plant at Vancouver, Wash., which will increase production by 50%, at an estimated cost of more than $1 million.

Dragon Cement Corp., subsidiary of U. S. Steel Corp., will build a new $10 million cement plant on a 1,500-acre site near the West Stockbridge-Richmond line in western Massachusetts.

Because of the dissolution of Graphite Products Division of Great Lakes Carbon Co., Cubical exchanger will now be produced by **Falls Industries, Inc.**

Pabco Products, Inc., has started construction of a $2.5 million gypsum wallboard plant on a 46-acre site near Florence, Colo.

Under a contract signed by **Atomic Energy Commission** and **Rare Metals Corp. of America**, El Paso, Tex., a $2 million uranium ore processing plant will be constructed at Tuba City, Ariz. Rare Metals is an affiliate of El Paso Natural Gas Co. and Western Natural Gas Co.

Continental Oil Co. and **Cities Service Co.** have acquired an interest in Mid-South Chemical Corp., Memphis, Tenn.

Gulf Oil Corp. has placed on stream the world's largest Platforming Unit at its refinery at Port Arthur, Tex.

Continental Oil Co. plans a $1 million expansion program at its refinery at Billings, Mont.

Koppers Co. has been awarded the contract for 87 new coke ovens for Inland Steel.

Cornwell Chemical Corp. has announced plants for additional sulfuric acid facilities at Cornwells Heights, Pa.

Search for new and improved products and processes in the fats and oils field will be conducted in

OLDBURY
1896 ®

ALKYL ACID PHOSPHATES

(ALKYL PHOSPHORIC ACIDS)

Partial List • Light color to colorless

1. Methyl Acid Phosphate
2. n-Butyl Acid Phosphate
3. Amyl Acid Phosphate
4. Iso Octyl Acid Phosphate
5. Lauryl Acid Phosphate

These and other alkyl acid phosphates including mixed alkyl acid phosphates are available in quantities ranging from experimental to semi-commercial.

Technical information and samples on request.

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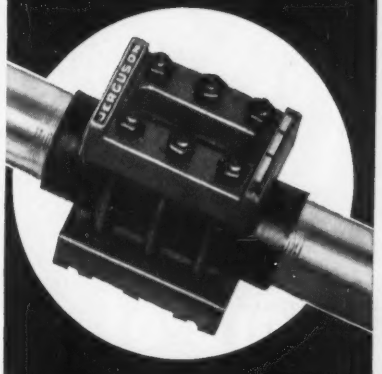
NEW . . .
Jerguson Sight Flow Indicators



easily and inexpensively installed to show movement of liquid in pipe lines

Here is a new line of Sight Flow Indicators . . . easily and inexpensively installed in any new or existing pipe line ½″ to 2″ N.P.T.

The special design of these new indicators results in a turbulence in the flow of liquid, making it easily visible. Several types of indicating vanes, installed within the chamber, may also be furnished, according to variable conditions of rate of flow and viscosity of liquid. For indication of minute flows, small Sight Flow Indicators with a rotating vertical rising ball are available.

Jerguson Sight Flow Indicators are soundly designed, carefully made, and are backed up by a company with over 40 years experience in the field. Available in Transparent and Reflex types, in a wide variety of materials and linings, and with Wedge Type Illuminators, Haveg Chambers, Non-Frosting Glasses, or other special construction.

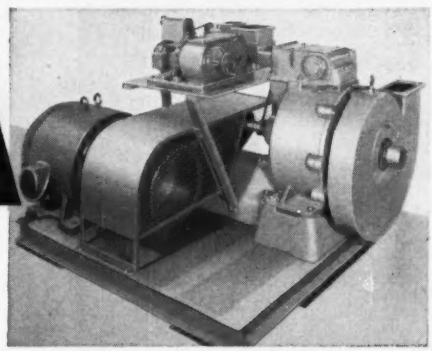
If you have a problem of viewing the flow of liquid in a pipe line, it will pay you to investigate the new Jerguson Sight Flow Indicators today. Send us your requirements or write for Data Unit.

JERGUSON
Gages and Valves for the Observation of Liquids and Levels
JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Offices in Major Cities
Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

Do You Need ULTRAFINE GRINDING?

FOR UNEXCELLED QUALITY WITH CONTROLLED PARTICLE RANGE

use a SCHUTZ-O'NEILL PULVERIZER



Backed by 62 years experience!

If your product must be pulverized to ultrafine specifications and yet have controlled particle size distribution, you'll find proven Schutz-O'Neill "Superfine" Pulverizers best for the job.

Many products that are heat sensitive can be pulverized safely too, because the grinding principle of impact with air attrition keeps product temperatures down and helps control humidity.

Versatility of the Superfine Pulverizers makes them adaptable to the complete range of grinding from coarse to ultrafine. Schutz-O'Neill Superfine Pulverizers are used in the paint industry where ultrafine pigments with close particle size range are vital; by major cocoa powder, sugar, spice and pharmaceutical manufacturers; for emulsifier gums, resin, plastic and seaweed extract powders—wherever unexcelled quality grinding is required. Offered in 6 sizes ranging from 7½ to 125 HP with grinding chambers 12″ to 28″ in diameter.

FREE TEST GRIND OF YOUR PRODUCT

in our test lab! Tell us your milling requirement—fineness, uniformity, increased output, lower cost—send us a sample of the stock you want to pulverize, state fineness and capacity desired. You'll receive back your processed product plus our Engineering Test Report—there's no obligation.

Send for literature on Schutz-O'Neill Pulverizers

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SCHUTZ-O'NEILL COMPANY
PULVERIZERS · GRANULATORS · ROLLER MILLS · AIR CLASSIFIERS · SIFTERS · HAMMER MILLS
301 Portland Avenue • Minneapolis 15, Minnesota

FIRMS . . .

the new **Twitchell Memorial Laboratories** recently completed by Emery Industries, Inc., Cincinnati.

Cherry-Burrell Corp. recently completed a new single story, high bay tank shop at its Little Falls, N. Y., plant No. 2, to meet the demand for space in which to construct more storage tanks and other large vessels for dairy, beverage, food, chemical and other industries.

Crown Zellerbach Corp. has selected St. Helens, Ore., as the site for a $750,000 green veneer mill. It will mark the paper firm's entry into the plywood business in this country.

Sunray Mid-Continent Oil Co. has been named to operate a new low-temperature absorption type gasoline plant with dehydration facilities to be built at Corpus Christi, Tex., by 13 oil and gas producers.

Du Pont Co. will build a new paint plant at Tucker, Ga., and a sales office and paint service warehouse building in Atlanta, Ga.

Foster Grant Co., Leominster, Mass., has announced substantial expansion of its polystyrene manufacturing plant and research facilities.

Houdry Process Corp. has announced that the first European Iso-Plus Houdriforming unit for production of 100 clear octane gasoline will be built in Ravenna, Italy, for SAROM.

Aluminum Co. of America has been granted a certificate of necessity for up to $2.5 million for expansion of heat treating facilities at its Alcoa works.

Diamond Alkali Co. has announced the formation of Diamond Chemicals of Puerto Rico, Inc.

General de Productos Quimicos Fadales, S. A. will operate a new plant in Medellin, Colombia, to

New... AMINCO

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by the Pioneers in design and construction of commercial high-pressure equipment . . .

★ PRESSURES TO 100,000 PSI

★ TEMPERATURES TO 1000° FAHR.

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- VALVES
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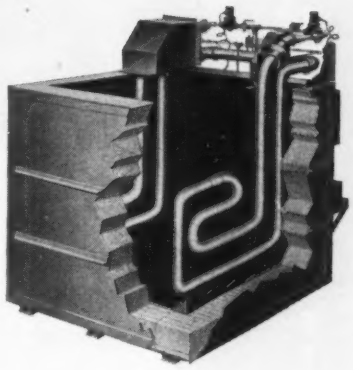

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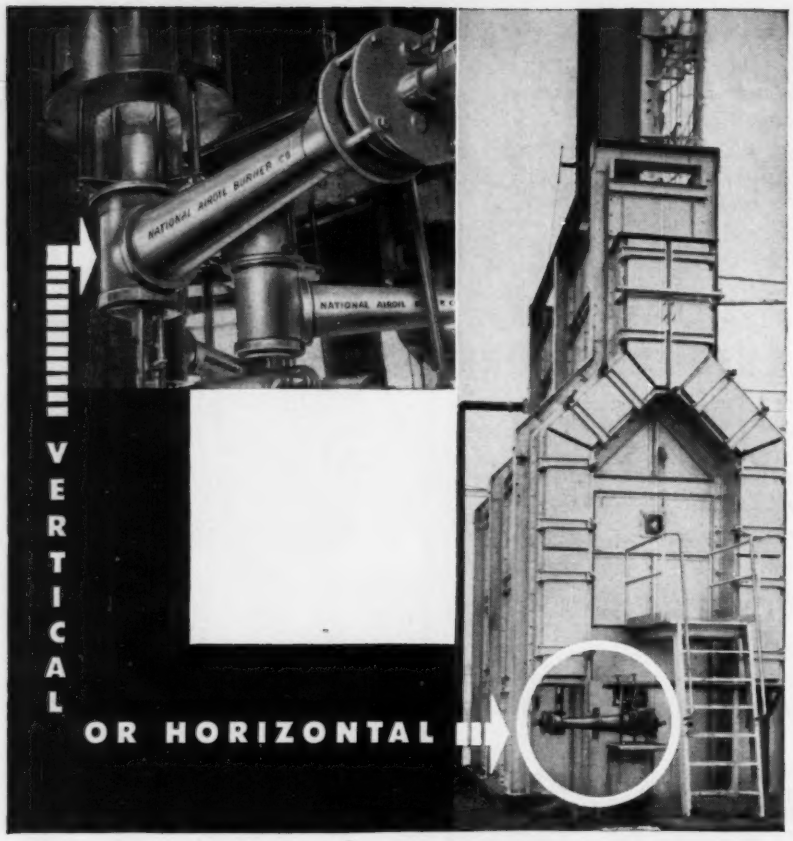

many more hours on stream without forced shutdown with NATIONAL AIROIL

OIL-GAS TANDEM COMBUSTION UNITS

Exclusively for vertical firing, the new National Airoil VERTICAL Tandem Block Units retain all the features of our regular horizontal Tandem Units . . . *plus:* special, pre-cast refractory shapes for easier, cost-saving vertical installation and maintenance; secondary air inlet louvres for positive control of vertical flame pattern; and, all steel duplex detaching gear which enables swift, simple vertical burner changeover.

VERTICAL and HORIZONTAL Tandem Units hold air in the combustion zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: high fuel economy through more rapid combustion with a minimum of excess air. NATIONAL AIROIL's patented Tandem Combustion Units allow secondary air to be easily and accurately controlled. By adjusting air control louvres, flame can be shaped to radiate heat uniformly without tube impingement.

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"Many, many more hours on stream, without shutdown" . . . yes, YOU will realize higher profits from YOUR heaters when NATIONAL AIROIL VERTICAL or HORIZONTAL Tandem Units are specified. Our new Bulletin 498 is yours for the asking.

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FIRMS . . .

turn out synthetic resin emulsions under license from the chemical division of Borden Co.

Panelyte division of St. Regis Paper Co. has announced a $500,000 expansion program to increase production of injection-molded and vacuum-formed plastics.

Ground has been broken for **Owens-Illinois'** glass container manufacturing plant at Portland, Ore.

Hudson Pulp & Paper Corp., New York, N. Y., in exchange for shares of its class A common stock, has acquired the multiwall bag manufacturing business of Hammond Bag & Paper Co., Wellsburg, W. Va.

Goodyear Tire & Rubber Co., Inc.'s chemical division has established three new sales departments: rubber and rubber chemicals, plastics, coatings.

Farris Engineering Corp. has established a new plant in Houston, Tex., as part of a general expansion program covering both its manufacturing and sales facilities.

Ground has been broken at Tacoma, Wash., for a $10 million refinery for **U. S. Oil & Refining Co.**

Phillips Pacific Chemical Co., jointly owned by Phillips Petroleum Co. and Pacific Northwest Pipeline Corp., will build an ammonia fertilizer plant in southeastern Washington.

G. Barr and Co. has opened an expanded research and development laboratory, largest in the aerosol filling field, in Chicago.

Bakelite Co. has announced plans to expand production of its vinyl resin latex WC-130, base resin of durable, easy-to-apply paints and coatings for interior or exterior use.

Houghton Laboratories, Inc., Olean, N. Y., has announced a

How light should a gas cylinder be?

HARRISBURG Cylinders are made with an eye to the future and their ability to pass successive quinquennial tests.

They are as light as is consistent with *well-balanced design and construction.* Their most important characteristic is their unequalled uniformity of wall thickness. This unusual regularity effects an even distribution of strength throughout. There is not a weak point in a HARRISBURG Cylinder, no spot too thin or too thick.

For the sake of safety and long service life, buy HARRISBURG Gas Cylinders.

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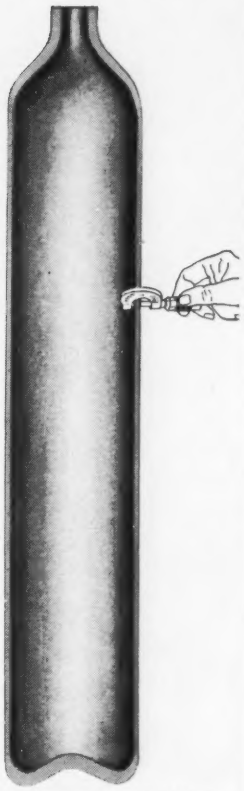

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sodium bromide crystallization solution

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molasses, vat dye solution, trioxide pickling solution, tall oil

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phenolformaldehyde, urea formaldehyde, asphalt, starch sizing

62,500 lb
soft drinks, 70% caustic liquor, black liquor, sulfuric acid pickling bath

And remember—both Dow Corning Antifoam AF Emulsion and Antifoam A are physiologically harmless. Both increase production, reduce processing time, eliminate the waste and fire hazard of boil-overs.

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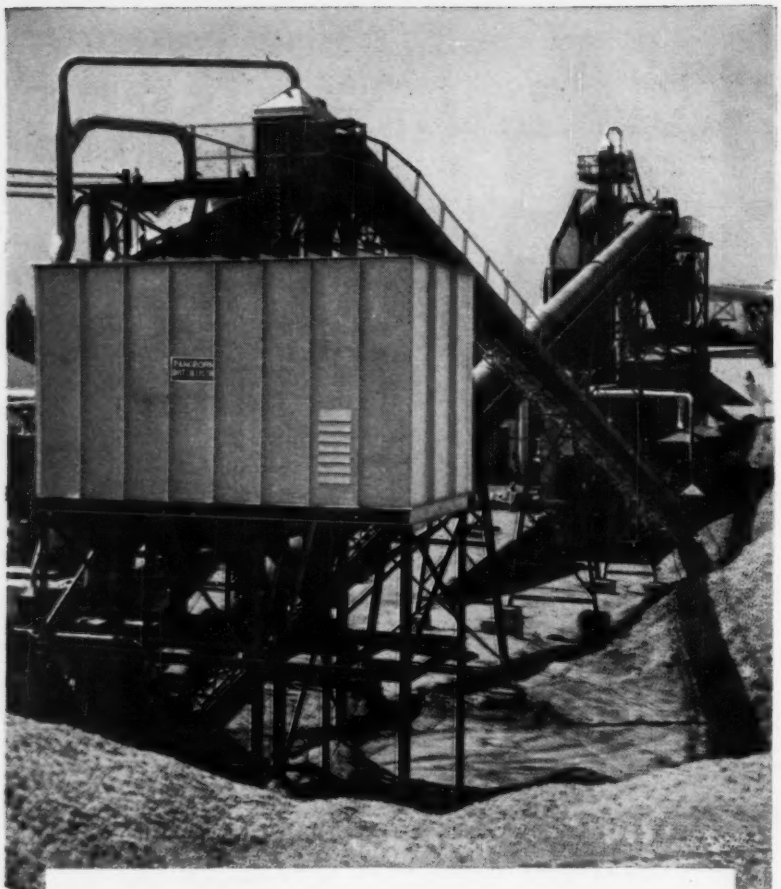

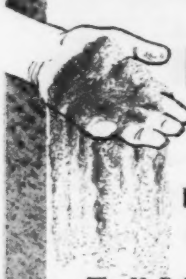

Fletcher brings dust "down to earth!"

Pangborn Dust Control collects valuable material to be sold as soil conditioner

The H. E. Fletcher Co., West Chelmsford, Mass., produces a wide variety of granite products. When Fletcher recently expanded plant operations, the firm installed Pangborn Dust Collectors on the recommendation of an already-satisfied user of Pangborn Dust Control. The results at Fletcher have been extremely gratifying. Costs have been cut in three ways: valuable collected material is sold as soil conditioner, the life of expensive machinery is lengthened by reducing dust damage, and plant housekeeping is cheaper and easier. Other benefits, according to the company, include the reduction of health hazards to employees and the improvement of product quality.

Pangborn can solve *your* dust problem. Pangborn engineers will be glad to show you how Pangborn Dry or Wet Dust Collectors can save you time, trouble and money!

See how Pangborn benefits varied industries. Write for free copy of "Out of the Realm of Dust." Pangborn Corp., 2600 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment.*

Pangborn
CONTROLS DUST

FIRMS . . .

new expansion program for its research department. A new research building will double the floor space and capacity of former quarters.

Westinghouse Electric Corp. has formed an industrial heating division.

Metal & Thermit Corp. will establish a combined general office, research and distribution center, representing a total investment of over $2 million, in Rahway, N. J.

Antar-Petroles de l'Atlantique will build a 10,800-bbl.-per-day Houdriformer at its refinery in Donges, France.

Stauffer Chemical Co. has begun construction of a liquid aluminum sulfate plant at Tacoma, Wash., in conjunction with its fertilizer plant.

Celgar Development Co. of British Columbia has received final approval for a 357,000-acre forest management license to enable construction of a $30 million, 300-ton-per-day pulp mill at Caselgar in the Arrow Lakes region.

Tennessee Eastman Co. has awarded a contract to the Girdler Co. to engineer and supply equipment for a high purity hydrogen plant at Kingsport, Tenn.

General Foods' board of directors have formally approved final building plans for a new food research center in Tarrytown, N. Y.

Pennzoil, division of South Penn Oil Co., Bradford, Pa., will start edging into the petrochemical field with the completion of new installation of processing equipment at its Oil City, Pa., plant within the next few months.

Thermatomic Carbon Co., affiliate of Commercial Solvents Corp., is constructing additional laboratories for studying the applica-

In these books

All these chemical plant aids . . . at your fingertips

1 A cross section of the manufacturing procedures employed by modern chemical industries, largely separated into their unit processes and operations by flow charts.

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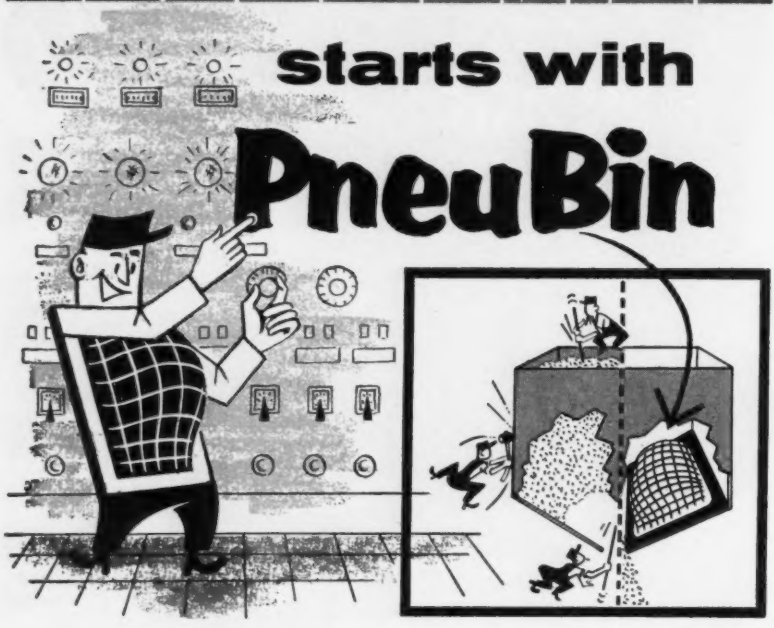

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FIRMS . . .

tion of carbon blacks in all phases of industry at its Sterlington, La., plant.

Monsanto Chemical Co.'s plastic division has formed a structural plastics engineering group, believed to be the first such specialized unit in the plastics industry.

Pennsylvania Power & Light Co. will build a privately financed, atomic-electric power plant of at least 150,000 kw. utilizing the homogenous-type reactor.

Leonard Construction Co., Chicago, has been awarded the contract to build a 500-ton-per-day contact sulfuric acid plant for Consolidated Chemical Industries Inc. at LeMoyne, Ala.

Schering Corp. will build an integrated biological research center, first unit in an expansion of the company's research and manufacturing facilities, at Bloomfield, N. J.

Farbwerke Hoechst A. G. is negotiating with the Indian government to set up a manufacturing plant for its products in India.

Atomic Energy Commission has selected a site near Germantown, Md., for its new headquarters building.

Rohm & Haas Co. has completed a new and larger building for its plastics research and development laboratory at Bristol, Pa.

Shawinigan Resins Corp. has completed expanded facilities for production of Butvar specialty resins at Springfield, Mass.

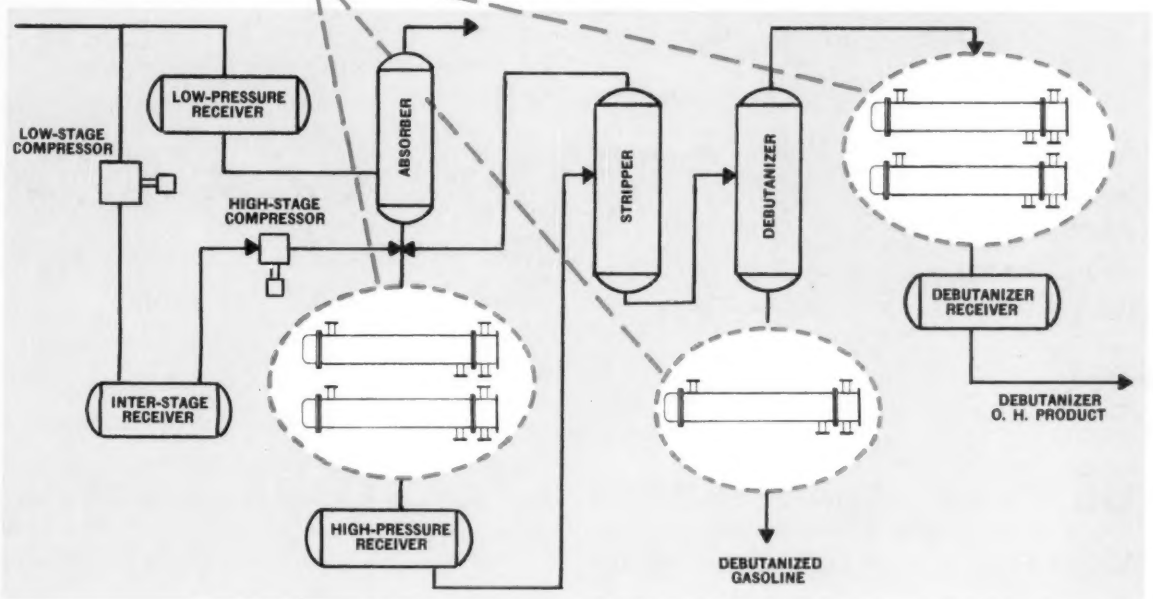
Kaiser Gypsum Co. will build a second gypsum products plant at Pittsburg, Calif., to replace its Redwood City plant destroyed by fire last June 23.

Wilputte Coke Oven Division, Allied Chemical & Dye Corp., has been awarded the contract for the design and construction of

No. 10 of a series of advertisements showing new opportunities in heat exchange design.

NEW GAS CONCENTRATION UNIT GOES ON STREAM

using Wolverine Trufin Type S/T Condenser Tube*



When it comes to picking a winner one of the best guides is—PAST PERFORMANCE.

That's the yardstick used by a large Midwest Refinery. As a result, when their new gas concentration unit went on stream recently, five of the heat exchangers were tubed with Wolverine Trufin Type S/T Admiralty Condenser Tube.

From previous experience this company knew that by using Trufin Type S/T they could *increase capacity, design smaller units* and *effect substantial savings in space requirements.*

Take a good look at the accompanying flow chart. It shows exactly how the following five heat exchangers were used:

1. High Pressure Cooler (two exchangers) Cooling high pressure gas system.
2. Debutanizer Overhead Condenser (two exchangers). Condensing and sub-cooling butane and lighter hydrocarbons.
3. Debutanizer Bottoms Cooler (one exchanger) Cooling debutanized gasoline.

If you are designing new heat exchange equipment, Trufin Type S/T can serve you as effectively as it does this company. Because its fins are an integral part of the tube, Type S/T has more than twice the heat transfer surface of prime surface tube—transfers more BTU's per foot of tube. The result is increased capacity plus a gratifying saving in headers, baffles, tubing, labor and space requirement.

When retubing existing equipment Trufin Type S/T gives the same boost in performance and achieves the same economies. It is mechanically interchangeable with prime surface tubes of the same size. It can be rolled or brazed into headers by conventional methods. Trufin Type S/T is available in a wide range of sizes and alloys in copper, aluminum and electric-welded steel.

Remember—when designing new equipment or retubing existing units—specify Wolverine Trufin Type S/T. You'll achieve new standards of efficiency and economy. For factual Trufin case histories and helpful design information, write today for your copy of the Trufin Opportunity Book.

WOLVERINE TUBE, 1443 Central Avenue, Detroit 9, Michigan.

*REG. U. S. PAT. OFF.

WOLVERINE TUBE
DIVISION OF CALUMET & HECLA, INC.
Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

THE WELD IS SOUND

Electric-welded steel tube is finding increasing favor in heat exchange and condensing operations particularly where low cost installations are desired. The following questions are typical of the many answered by Wolverine's Field Engineering Service.

Q. How sound is the weld in steel tubing?

A. With modern welding techniques the weld is as strong as the tube wall and has the same top quality as the steel from which the tube is formed.

Q. Does Wolverine electric-welded steel tube pass standard testing procedures?

A. You can be sure of that. Flattening, reverse flattening, expanding and flanging of tube sections assure constant weld quality. In addition, each condenser tube must meet hydrostatic tests well over a fibre stress of 20,000 psi.

Q. Is Wolverine Trufin* available in electric-welded steel form?

A. Yes! Wolverine manufactures integrally finned Trufin in electric-welded steel as well as in copper, copper alloys, aluminum and bi-metal. Incidentally, during Wolverine's exclusive finning process, electric-welded steel tube is cold worked while the integral fins are extruded from the tube wall—another graphic proof of the weld's ability to stand up.

Q. What do you mean when you say "Quality controlled from strip to finished product"?

A. Strip steel received by Wolverine must meet rigid specifications before acceptance. During the manufacturing process constant inspection insures that the tubing will meet Wolverine's high quality standards.

Q. Does your electric-welded steel tube have a brand name?

A. Indeed it does. In its prime surface form it is known as Wolverine Qualitube.* In its integral finned form it is known as Wolverine Trufin.

Wolverine electric-welded steel tube—either finned or prime surface—can help you realize new standards of low cost heat exchange efficiency. Next time you retube ask for a Wolverine quotation. Write, too, for your copy of the Wolverine Trufin Catalog.

*REG. U. S. PAT. OFF.

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DIVISION OF CALUMET & HECLA, INC.

Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

Wolverine Trufin is sold in Canada under the Unifin Tube Co., London, Ontario.

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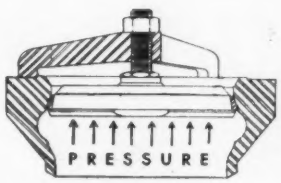

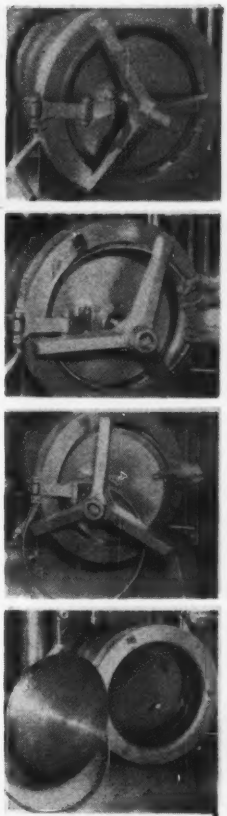

(1). Flex Ring Unit assembled as in service. (2). Spider released, gasket being removed. (3). After gasket is removed, plug is rotated to open. (4). Unit completely opened and in a fraction of time taken for conventional type closures.

SIMPLE and SAFE to OPERATE...

An entirely new design and seal principle, the SILLERS FLEX RING CLOSURE gives you many advantages and economies such as LOW INITIAL COST . . . LESS TIME IN OPENING AND CLOSING (JUST ONE BOLT) . . . TIGHTER SEAL AT HIGH PRESSURES . . . LESS WEIGHT . . . EASE OF HANDLING . . . and NO SEAL DESTRUCTION IN CASE OF FIRE. Sillers Flex Ring Closures are available in all standard sizes and can quickly be adapted for special applications.

GET COMPLETE DETAILS TODAY
SEND FOR BULLETIN NO. 3000

The perfect closure for Boilers, Evaportors, Heat Exchangers, Autoclaves, Filters, Strainers, Absorbers and all types of Pressure Vessels and Piping Systems.

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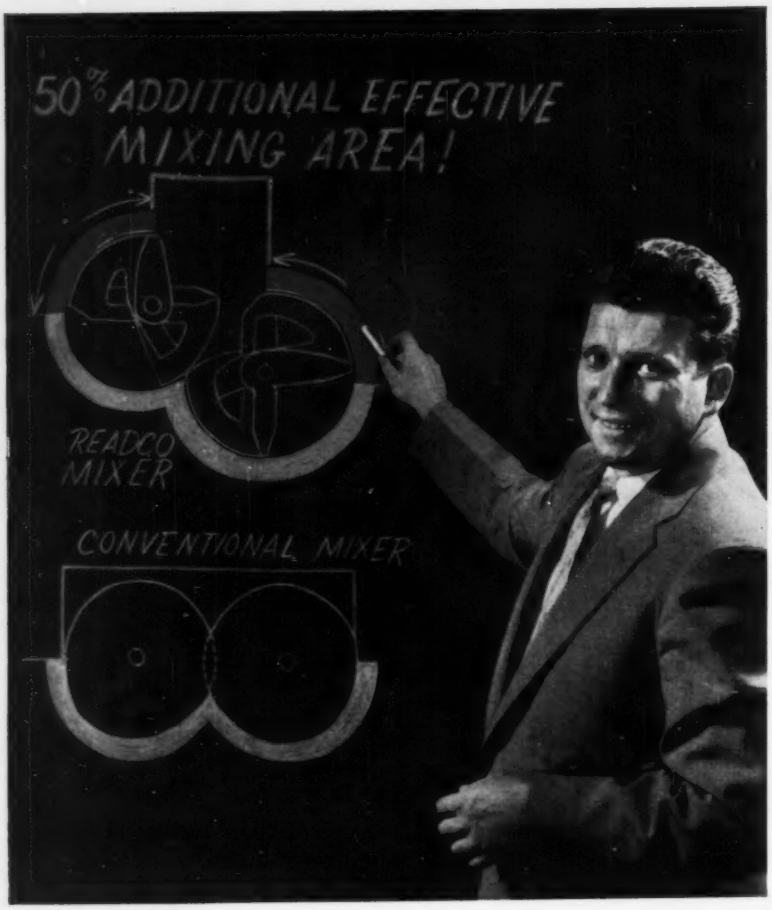
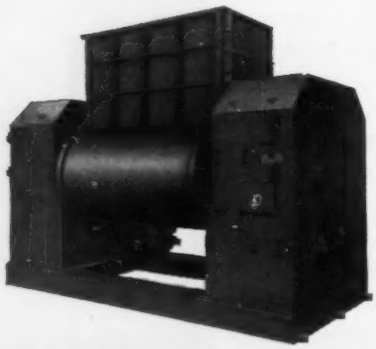


READCO'S IMPROVED MIXER DESIGN PROVIDES COMPLETE DISPERSION IN LESS TIME...FOR LESS COST



It's Readco's unique split-level dispersion bowl that makes the difference. It provides a greater ratio of surface to the volume of mix. Overlapping sigma arm mixing action exposes new surfaces and breaks down the entire mass with each rotation, producing a homogenous mix in a short mixing cycle, eliminating peak loads. Closer clearances between mixer arms and shell prevent build-up of materials.

Readco Paper Coating Mixers can be supplied for manual or hydraulic discharge in 150, 350 and 750 gallon working capacities. Write for complete information.

READ STANDARD CORPORATION

Bakery-Chemical Division
YORK, PENNSYLVANIA

FIRMS . . .

52 by-product coke ovens at the Wisconsin Steel Works, South Chicago.

Pittsburgh Plate Glass Co. has started construction on a multi-million dollar glass research center in Harmar Township, near Pittsburgh.

Union Carbide and Carbon Corp. will erect a 41-story building, to house the offices of the corporation and its divisions and subsidiaries, on the entire block between Park and Madison Aves. and 47th and 48th Sts. in New York City.

Youngstown Sheet and Tube Co. will build a new 75-oven coke plant at Indiana Harbor, Ind., works. Battery will convert 1,800 tons of coal to 1,250 tons of coke per day.

U. S. Potash Co. will spend about $3 million to increase the output of its mine near Carlsbad, N. M., and to expand its refining facilities to provide about 20% additional capacity.

Union Oil Co. of Calif.'s Edmonds, Wash., refinery plans to expand with two stills for the manufacture of air-blown asphalt. Stills will be erected next to existing steam-blown asphalt facilities on Puget Sound.

West Coast Wood Preserving Co. has initiated penta pressure treatment at its West Seattle and Eagle Harbor, Wash., plants.

Monsanto Chemical Co.'s plastics division has opened the laboratories of a new research building at Springfield, Mass.

Nichols Fertilizer and Chemical Co., Oklahoma City, has purchased Oklahoma Fertilizer and Chemical Co., manufacturer of "Big Boy" and "Sunflower" fertilizers.

Thompson Chemical Co. will build a plant for the manufacture of polyvinyl chloride in North

Have you heard the news...?

General Mills Adds Crosby Tall Oil Fatty Acids to its Line of Aliphats

COOPERATIVE ARRANGEMENT OFFERS SPECIALIZED TALL OIL ACIDS WITH NEW ECONOMY, IMPROVED SPECIFICATIONS

To meet the increasing demand for more "tailor-made" chemicals, General Mills has arranged to market *tall oil* fatty acids produced by Crosby Chemical Company. They will be available to you from General Mills . . . as part of a full line of specialized fatty acids.

With increased volume, this cooperative arrangement promises you tall oil acids of unequalled quality at continued lower prices. Here's why.

Crosby boasts the latest large-capacity equipment designed solely to distill tall oil fatty acids. It also has ample stocks and sources of crude tall oil.

General Mills backs up the quality, assuring the same high standards as in the rest of the Aliphat line and *gives you the security of two supply sources.*

Typical of the new tall oil fatty acids is Aliphat 44-A . . . with improved specifications. Aliphat 44-A offers lighter color, higher iodine value, less unsaponifiables, and lower rosin acids than before.

By combining improved color with lower rosin acids and higher iodine value, Aliphat 44-A has improved immensely its value for alkyd resin manufacture. For example it is also ideally suited for white enamels and for metal surface coatings. For more data on these and other uses, mail the coupon below.

We also offer Polyamide Resins and Fatty Nitrogen Compounds.

PROGRESS THRU RESEARCH

General Mills CHEMICAL DIVISION • KANKAKEE, ILLINOIS

Please send me technical information on General Mills Aliphat 44-A. Our use for the product is:_____

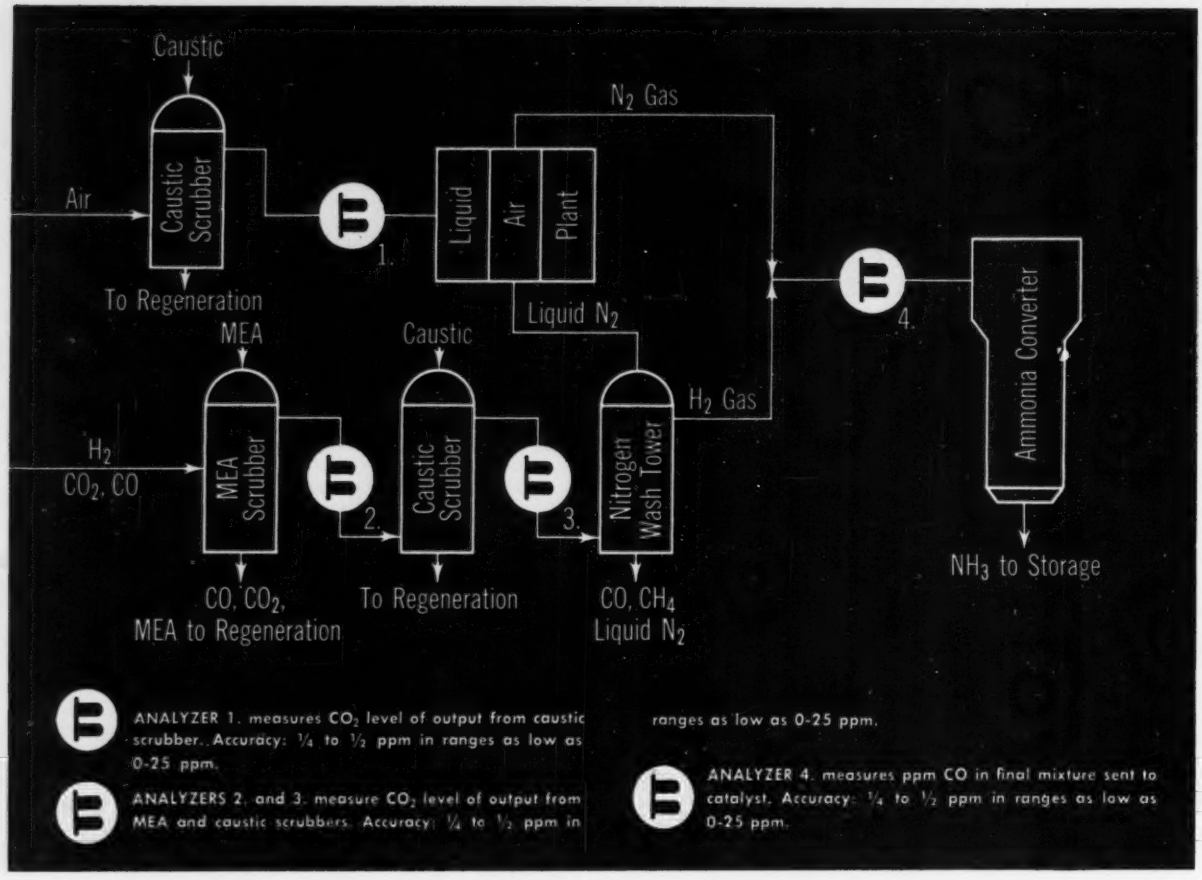
Name_____

Firm_____

Address_____

City_____ Zone____ State_____

4080-55


Caustic
Air
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To Regeneration
N_2 Gas
Liquid Air Plant
1.
Liquid N_2
4.
Ammonia Converter
NH_3 to Storage
MEA
Caustic
H_2 Gas
H_2
CO_2, CO
MEA Scrubber
2.
Caustic Scrubber
3.
Nitrogen Wash Tower
CO, CO_2, MEA to Regeneration
To Regeneration
CO, CH_4 Liquid N_2
ANALYZER 1. measures CO_2 level of output from caustic scrubber. Accuracy: ¼ to ½ ppm in ranges as low as 0-25 ppm.
ANALYZERS 2. and 3. measure CO_2 level of output from MEA and caustic scrubbers. Accuracy: ¼ to ½ ppm in ranges as low as 0-25 ppm.
ANALYZER 4. measures ppm CO in final mixture sent to catalyst. Accuracy: ¼ to ½ ppm in ranges as low as 0-25 ppm.

in a 250 ton per day ammonia plant . . .

CONTINUOUS ANALYZERS INCREASE OUTPUT 10%

. . . save $16,000 a year

Perkin-Elmer *continuous* infrared analyzers can increase the efficiency of *your* process – by doing away with "analytical lag," moving the laboratory right out to the process line. Take this example of an ammonia plant.

A P-E TRI-NON* Analyzer (Number 1. in flow diagram) continuously measures CO_2 level–determines optimum balance between caustic use and CO_2 removal efficiency. If NH_3 throughput is 250 tons a day, raising caustic utilization from 70 to 80% or more means a saving of $4,500 to $6,000 a year.

Analyzers 2. and 3. measure the CO_2 level of output from MEA and caustic scrubbers. At this level, the equipment is paid off in less than a year.

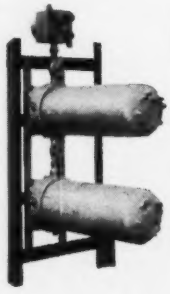
Analyzer 4. measures ppm of CO in final mixture sent to the catalyst. With proper control of CO level, $8,000 to $10,000 can be saved by extending catalyst life. The analyzer pays for itself in 6 months!

When you specify continuous analyzers for your process streams, only P-E has a complete line of instruments to choose from. Or let us develop a complete analytical control system for you. Nowhere else can you get the combination of chemical engineering and instrument know-how that you'll find at P-E. *T. M.

Perkin-Elmer

CORPORATION

Norwalk, Connecticut



P-E TRI-NON Analyzers are available in a wide range of models and prices to meet all types of continuous analytical problems. They are rugged and dependable, expressly designed for use in the varied environments of a processing plant or refinery. For quick and easy maintenance, instrument components can be tested right on stream — without disconnecting.

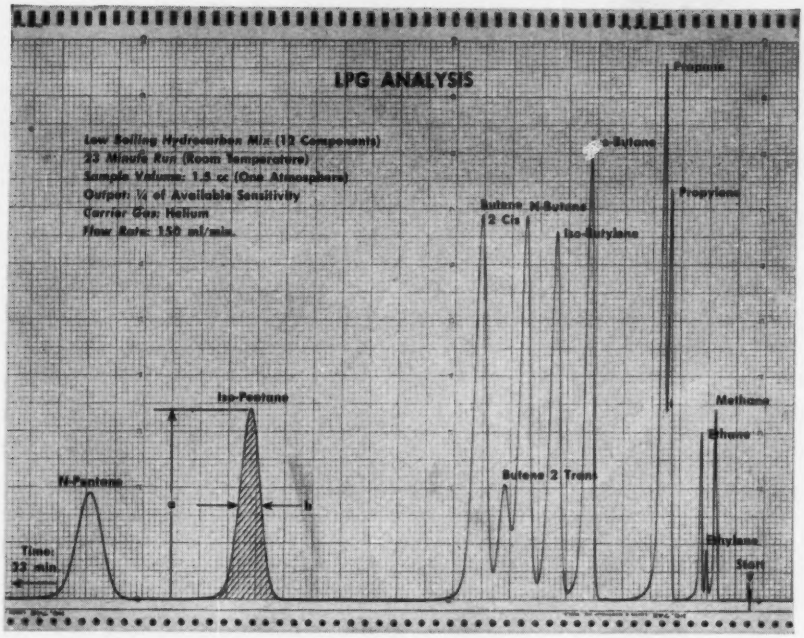


Photo of actual run made on new P-E Vapor Fractometer. To find mole % concentration of a component, analyst simply integrates area under peak by multiplying peak height (a) times half-band width (b).

This quantitative analysis took only 23 minutes on the new P-E Vapor Fractometer that costs only $1,375

HOW LONG WOULD IT TAKE YOU?

Employing the principles of gas chromatography, P-E's new vapor fractometer is a revolutionary advance in the field of gas and volatile-liquid quantitative analysis. It is fast, precise, uncomplicated to operate, extremely simple in calculation, and above all, many times less expensive than distillation columns, mass spectrometer, or any other instrument, for the purpose.

For qualitative analysis, the instrument gives extremely clean separations—even of components and isomers which cannot be separated by ordinary methods. For trace analysis, high sensitivity permits use of extremely small samples.

Take, for example, the analysis of a synthetic LPG mix shown above. Here 12 components, representing the hydrocarbons most frequently encountered, were clearly separated—a job extremely difficult to accomplish by ordinary vacuum distillation methods. The perfect shape of the recorder bands makes quantitative analysis simple and accurate. Area under each peak is the measure of the mole % concentration of the component. These area relationships are all that is needed for calculation, without preliminary calibration for each individual component.

There is no faster, no simpler, no more inexpensive method in existence today.

This is the Model 154 Vapor Fractometer—price, $1375.00 without recorder. Send for descriptive bulletin.

Perkin-Elmer CORPORATION
Norwalk, Connecticut

FIRMS . . .

Dighton, Mass. Scientific Design Co., Inc., has been engaged to design and engineer the plant.

Esso Research and Engineering Co. will build a three-story, laboratory-office building to accommodate 600 scientists and engineers at Linden, N. J.

Western Chemicals, Ltd. has completed expansion of its Duvernay plant near Edmonton, Alta. Plant now has a rated capacity of 20 tons per day of chlorine and 24 tons daily of caustic soda.

Giant Portland Cement Co. plans to expand its Harleyville, S. C., plant to boost capacity 60%.

Permante Cement Co. will expand its operations into Southern California with construction of a new $12 million cement plant in San Bernardino County.

Magnolia Petroleum Co. has planned six-project construction program at its Beaumont, Tex., refinery, which will bring cost of plant's planned expansion to about $25 million.

North Star Oil Co., Ltd., Winnipeg, Manitoba, plans to construct a $2.5 million oil refinery at Grand Prairie, Alta.

Reichhold Chemicals, Inc., has opened a new plant in Kansas City, Kan.

Rayonier Inc. will establish a new research center on an 82-acre site at Whippany, N. J.

U. S. Vanadium Co. will soon begin a large expansion of its uranium processing plant at Uravan, Colo.

Weyerhaeuser Timber Co. has announced plans to expand its research and development facilities at Longview, Wash.

Connecticut Chemical Research Corp. has acquired the Goodyear Rubber Sundries Co., New Haven, Conn.

TWO FOR THE MONEY...

Chemist and Engineer—

one in a development group creating new chemical forms and compounds to make Celanese* petrochemicals more productive industrial materials. The other in a special engineering section devising new processes and controls to produce these chemicals economically—and in continuous market-stabilizing volume.

Result: chemicals that shorten manufacturing cycles, produce greater yields, cut costs, increase the value and usefulness of hundreds of end-products.

If you're looking for improvements that start with better working chemical materials, send for a copy of the new Celanese product index. You'll find that Celanese "double-teaming" has been working in your direction.

Celanese Corporation of America, Chemical Division, Dept. 582-J 180 Madison Avenue, New York 16, N.Y.

*Reg. U.S. Pat. Off.

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Glycols
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Ketones
Oxides
Polyols

Plasticizers
Salts
Solvents
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Vinyl Monomers

Celanese*
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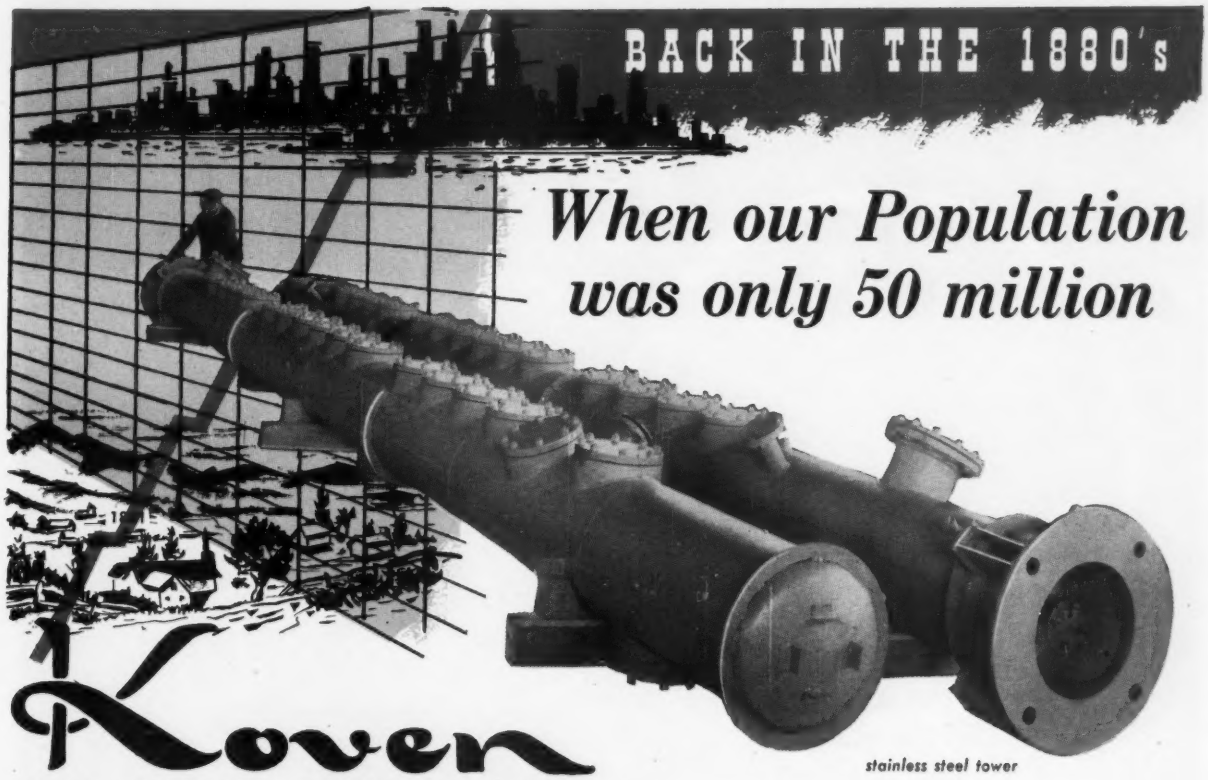
CHEMICALS

In textiles, plastics, agriculture, paper, surface coatings, electrical and building materials and equipment, pharmaceuticals.



When our Population was only 50 million

stainless steel tower

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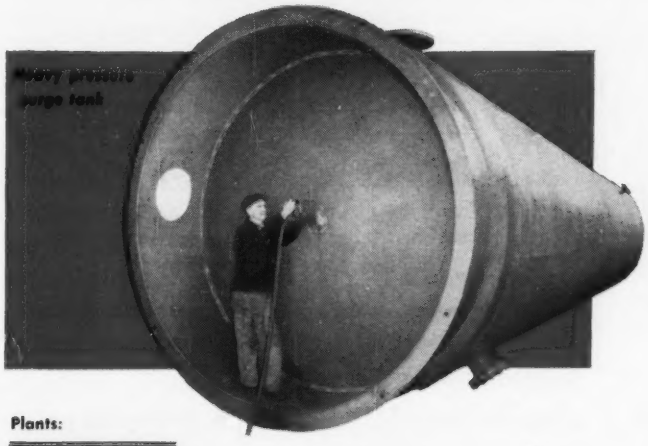
WAS MAKING INDIVIDUALIZED CHEMICAL EQUIPMENT



Today's population of 165 million is proof of a potential realized — and the accomplishments of these millions continue daily to reaffirm our strength. KOVEN, one of America's leading steel fabricators, has been a part of the industrial growth and achievement which has accompanied our population increase. The results of almost 75 years of experience, research and skill are what KOVEN brings you. For fast, efficient, economical output; for individualized equipment—built to your exact needs—call or write for a consultation with a KOVEN representative—of course, no obligation. Send for Bulletin #550.

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Fabrication to all A.S.M.E. Codes

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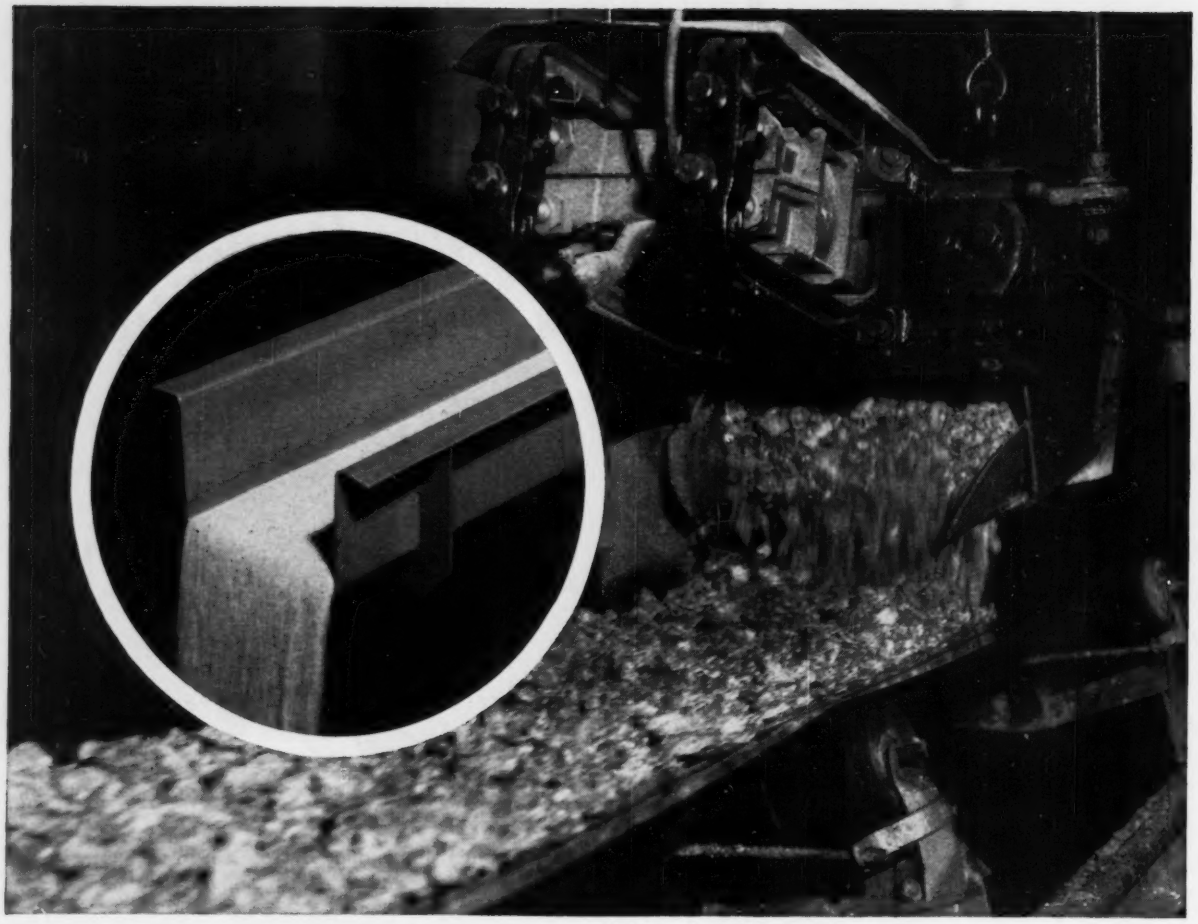
KOVEN FOR INDIVIDUALIZED EQUIPMENT SINCE 1881.



Jeffrey puts VIBRATION to useful work

You can solve many problems of conveying solid materials with Jeffrey Electric Vibrating Feeders. Move fine powders or huge stone blocks . . . a few ounces or two thousand tons per hour . . . dripping wet or bone dry . . . at temperatures ranging from 30° below zero to 2,000° above. Materials are propelled in a smooth, continuous stream by each forward vibration stroke.

Balanced vibration in the Jeffrey system matches electrical frequency to natural mechanical frequency of the driven equipment. This makes the system highly economical to operate, since all available energy does useful work. It is easy to control, safe, quiet and dependable. Vibration is scientifically isolated within the conveyor.

Jeffrey's years of experience with conveying problems enable us to furnish systems exactly right for each particular task. Catalog 870 describes the complete line of Jeffrey Vibrating Equipment. For a copy, and for help on your conveying problems, write The Jeffrey Manufacturing Co., Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT • TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

"THE BRAND OF PROGRESS"

By Heat Exchanger Specialists

▲ SYNOPSIS OF AD #6: The many complexities of the modern processing industries have greatly elevated the importance of the metallurgical engineers and welding technicians of Western Supply Company. These men, working as a team, have guided Western through years of delicate fabrication in the AISI Stainless Steels in the 300 series . . . High Chrome Irons . . . the Refiner's Alloys, the low chrome Moly Steels . . . Monel . . . Copper . . . Copper Silicon . . . . . . Nickel . . . Aluminum.

When fouling of heat exchanger tubes and shells is a tough problem . . . you can rely on the special metal design and fabrication experience of Western Supply Company.

Drilling a hole should be a simple operation. Thousands of work-shop hobbyists do it every day. But in the Western Supply Company plant, drilling a simple hole becomes a science.

These holes, in the stationary and floating tube-sheets must hold the heat exchanger tubes in a vapor or fluid-tight joint. Many tube-sheets have hundreds of such tube holes. A leak in any one, by permitting the mixing of shell-side and tube-side fluids, could prove costly, dangerous or both. To prevent this, TEMA (Tubular Exchanger Manufacturers Association) tube-hole tolerance for normal fit is plus/minus .002 of the specified tube hole diameter. In addition to tube hole diameter, the location of holes and accuracy of ligament between holes as well as tube hole drift are equally important factors.

To assure meeting TEMA specifications, Western's drilling technique is as follows:

1. After tube sheet machining, tube holes are scribed by the layout department.
2. Fully scribed, the hole locations are then carefully center punched.
3. With the completely layed-out tube sheet on the drill press, drill position is exactly established with a dead center tool and the radial drill locked into position.
4. The hole is drilled .015 under final specification.
5. The tube hole is reamed to size, normally .010 plus/minus .002 over nominal tube diameter.
6. All tube holes for Class R equipment have two 1/8" wide by 1/64" deep serrations.
7. All tube holes are chamfered 45° on both sides of tube sheet.
8. Tube sheets are chemically cleaned to de-grease prior to assembly.

That's "The Hole Story" behind every tube hole drilled at Western Supply Company for Western Heat Exchangers.

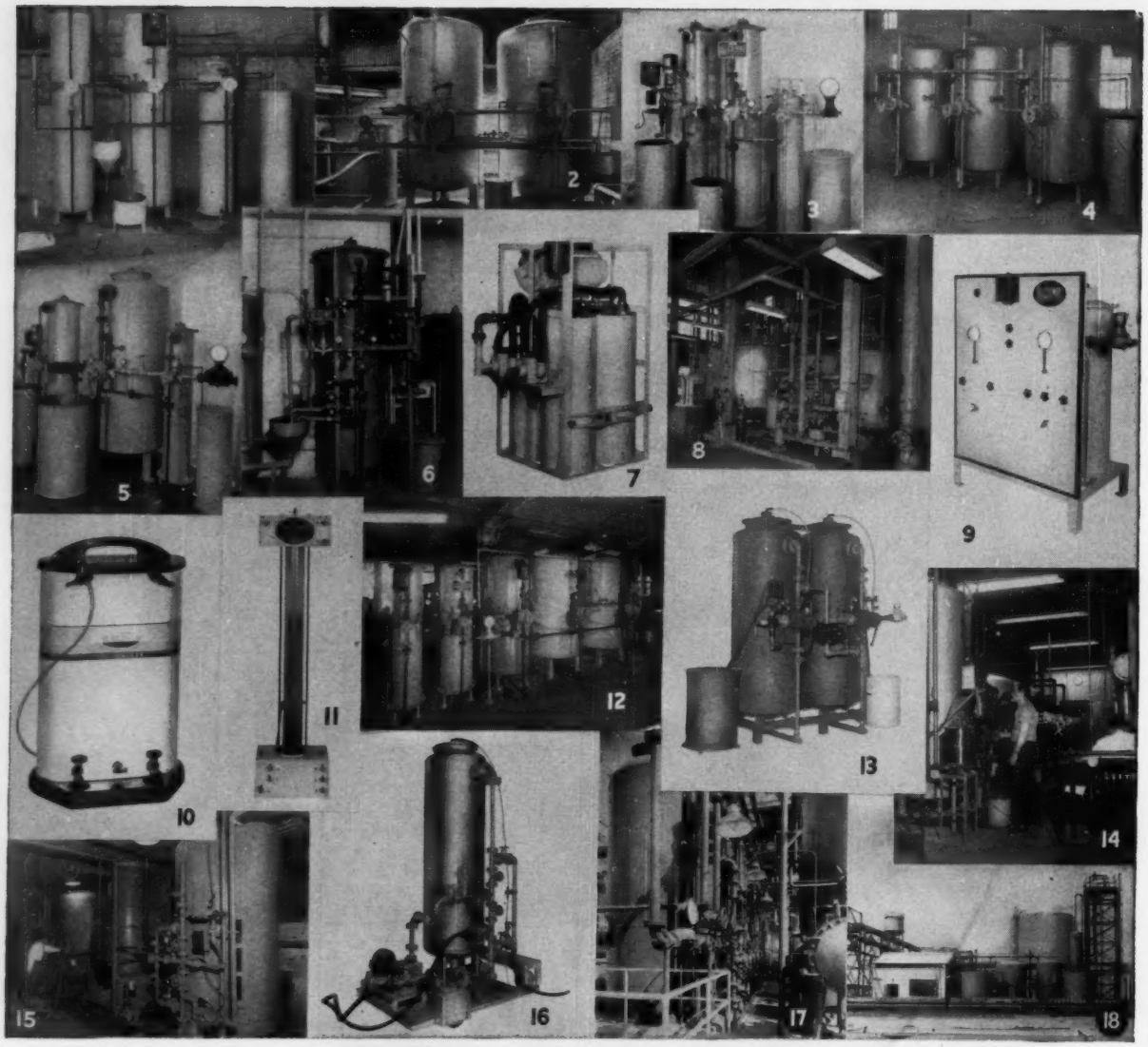
WESTERN

HEAT EXCHANGERS

WESTERN SUPPLY COMPANY

P. O. BOX 1888 • TULSA, OKLAHOMA

HUDSON-RUSH COMPANY—753 Gladstone Blvd., Shreveport, La.
130 Casa Linda Plaza, Dallas 18, Texas
PROCESS INSTRUMENTS & EQUIP. CO.—North Bldg., Charleston, W. Va.
H. W. SEVERANCE—Marion E. Taylor Bldg., Louisville, Ky.



1. First D-I* installation (1939). 2. Parallel Dealkalizer (1940). 3. Standard D-I equipment (1944). 4. Triplex Softener for power plant. 5. D-I and Softener for distillery. 6. Early Mixed-Bed D-I (1949). 7. Special portable compact D-I unit. 8. Corn syrup purification. 9. Standard "package" D-I unit LU-340. 10. Laboratory D-I unit. 11. Laboratory "package" Mixed-Bed unit MB-510. 12. D-I high-purity water for dry cells. 13. Drug purification, foreign. 14. Mixed-Bed for television tubes. 15. Cation-aeration-Mixed-Bed special. 16. Portable Mixed-Bed for chromic acid recovery. 17. D-I for glycerine purification in soap plant. 18. Outdoor D-I at large chemical company. (*De-Ionizer)

EXPERIENCE is the Important Factor in the design and manufacture of Ion-Exchange equipment . . .

These pictures, and the dates associated with some of them, are indicative of two important considerations: (1) that Illinois Water Treatment Company has been making ion-exchange equipment continuously since 1939, which was only a few years after the idea of ion-exchange was first conceived, and was the same year that practical ion-exchange resins were developed, and (2) that, in this time, Illinois Water Treatment Company, has successfully designed, built, and installed a *wide range of practical equipment* for utilizing the advantages of ion-exchange in many different ways. *Remember* this record of accomplishment . . .

ILLCO-WAY

ionXchange

ILLINOIS WATER TREATMENT CO., 844 CEDAR ST., ROCKFORD, ILL.

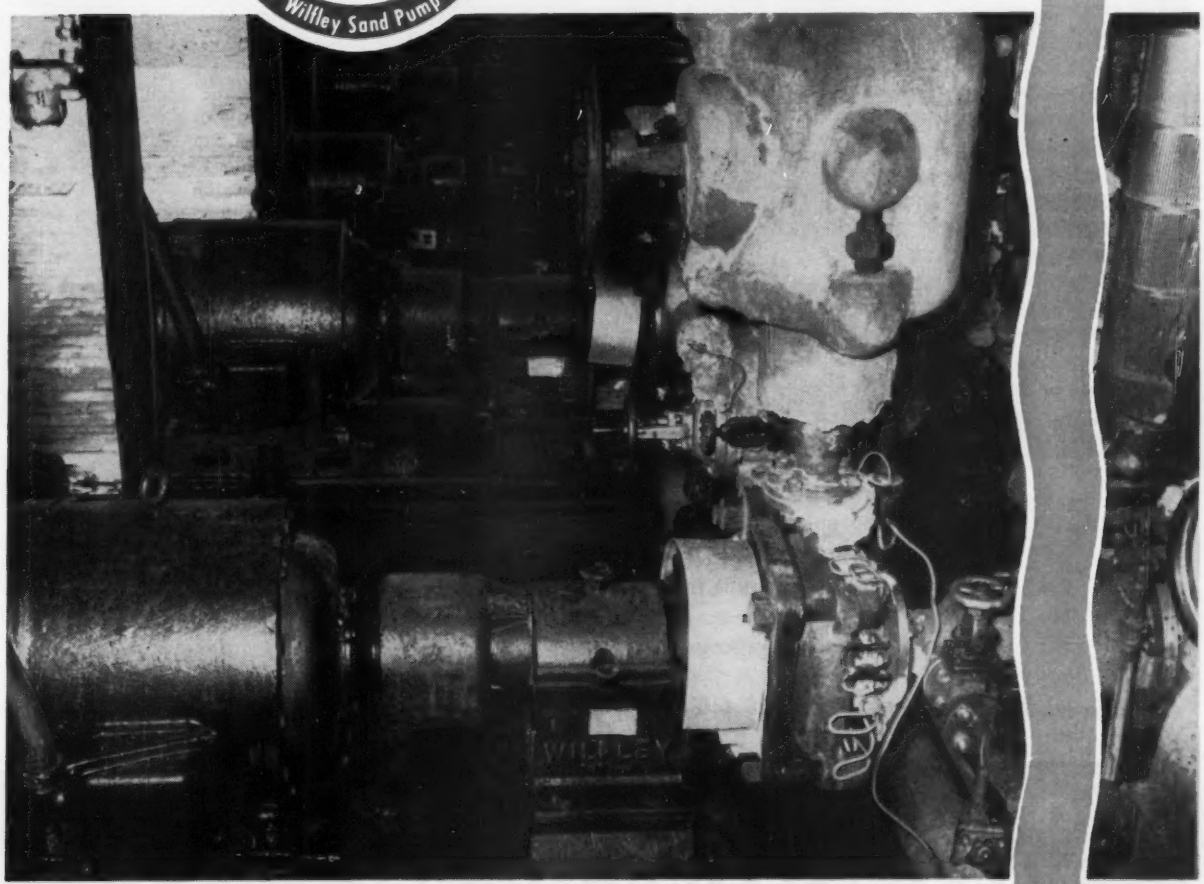
WILFLEY ACID PUMPS handling

Ammonium Nitrate at HIGH HEADS!

These highly efficient Wilfley Acid Pumps step up production and reduce pumping costs in this modern chemical plant. Wherever installed, Wilfley Pumps operate without attention, delivering trouble-free performance on 'round-the-clock schedules. Available with pumping parts of the machinable alloys as well as plastic to meet all requirements. Individual engineering on every application. Write or wire for complete details.

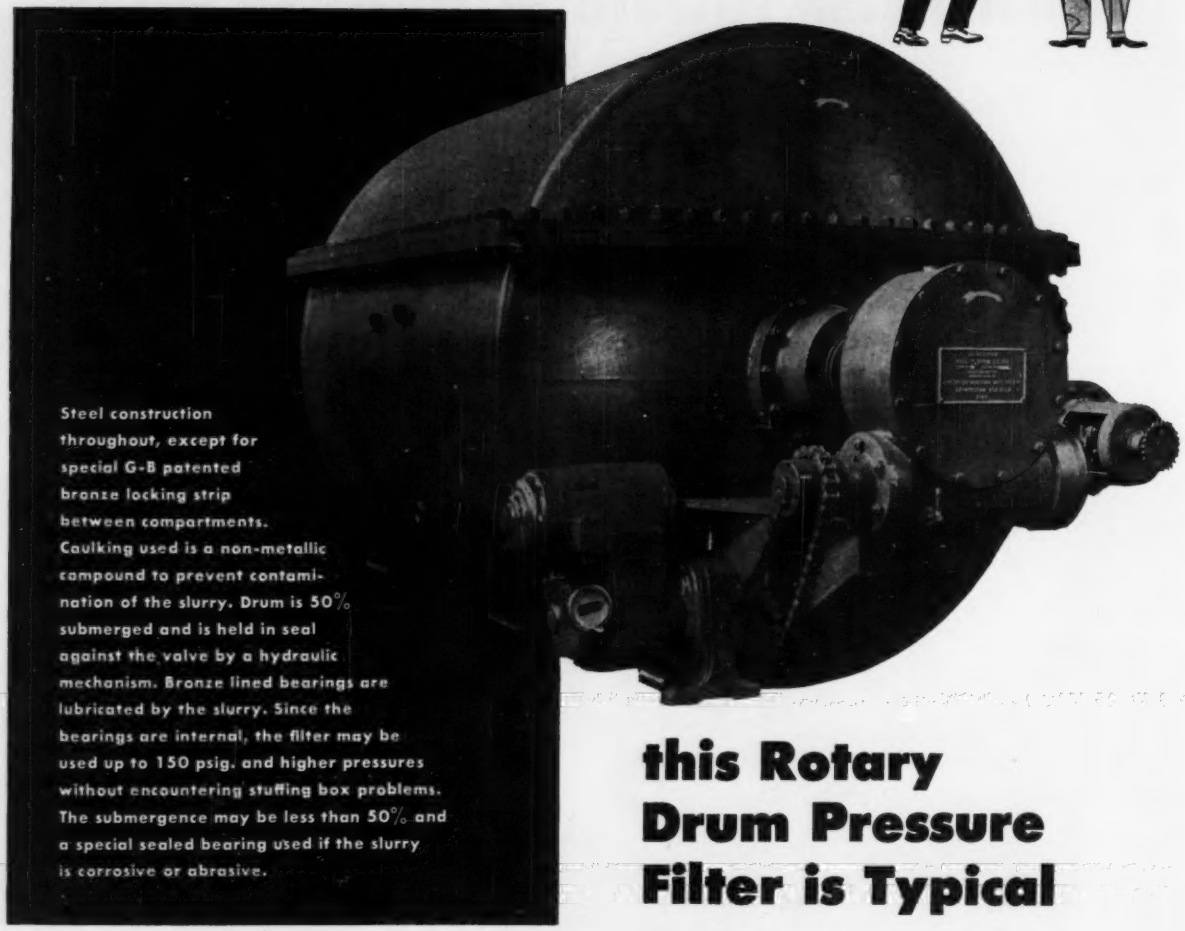
Wilfley Acid Pump
"COMPANIONS IN ECONOMICAL OPERATION"
Wilfley Sand Pump

Photo shows prilling tower pumps (steam jacket partially removed).



A. R. WILFLEY and SONS, INC. Denver, Colorado, U.S.A.
New York Office: 1775 Broadway, New York City

A Perfect fit



Steel construction throughout, except for special G-B patented bronze locking strip between compartments. Caulking used is a non-metallic compound to prevent contamination of the slurry. Drum is 50% submerged and is held in seal against the valve by a hydraulic mechanism. Bronze lined bearings are lubricated by the slurry. Since the bearings are internal, the filter may be used up to 150 psig. and higher pressures without encountering stuffing box problems. The submergence may be less than 50% and a special sealed bearing used if the slurry is corrosive or abrasive.

this Rotary Drum Pressure Filter is Typical

of the special designs G-B engineers develop to handle particular needs. The filter drum is 6'-0" in diameter by 8'-0" in length, and in this instance maintains a positive pressure of carbon dioxide on the filter cake to prevent the chemical reaction from reversing. Every detail has been worked out to fit the filter to the exact needs, rather than utilizing a "standard" filter and making the process conform to the filter.

Process-minded G-B Engineers will work with you, too... without obligation!

GOSLIN-BIRMINGHAM
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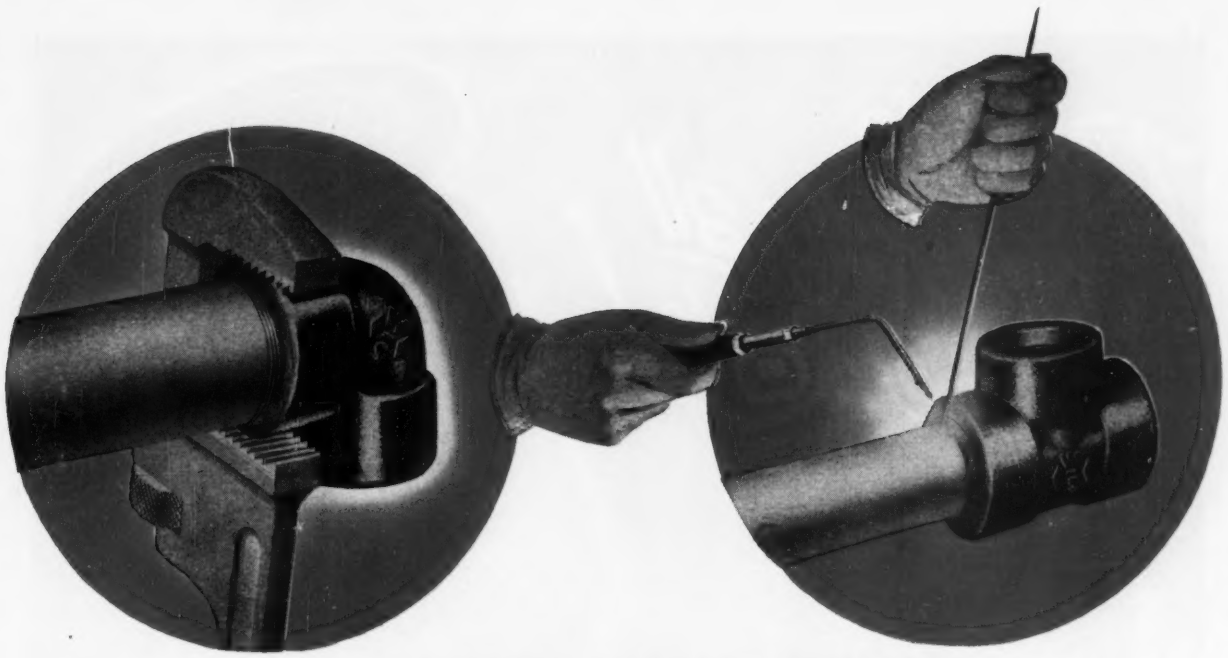

INSTALL WATSON-STILLMAN FORGED STEEL FITTINGS...

...and get THESE IMPORTANT ADVANTAGES:

- Resistance to Pressure, Heat and Corrosion
- Long Service Life
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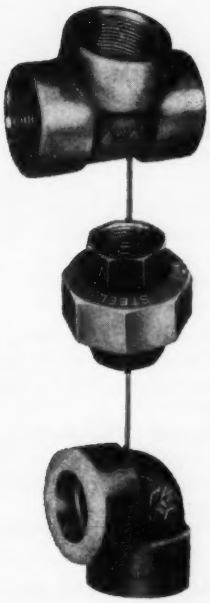


Watson-Stillman Forged Steel Pipe Fittings are fabricated and designed for tough service...and long service. They're drop forged of high quality metal to produce a strong, tough, fiber structure that resists the stresses of high pressures, shock and vibration. And our forged stainless and alloy steel fittings give you the added advantages of resistance to high temperatures and corrosion. Watson-Stillman Fittings assure you of safe, reliable service in process lines, high pressure steam lines and other arteries of the operating equipment in your plant.

You can obtain a complete line of W-S fittings to suit your service and fabrication requirements. Available in Screw-End and Socket-Welding Types in Carbon Steel, 1¼% Chrome-½% Moly steel, 2¼% Chrome-1% Moly steel, Types 304, 316 and 347 stainless steel and Monel.

Send today for our informative bulletins.

Sold through leading distributors

WATSON-STILLMAN FITTINGS DIVISION

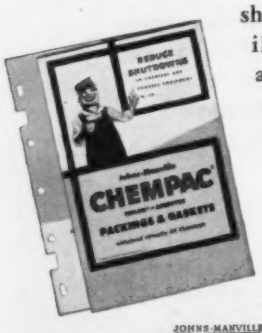
H. K. PORTER COMPANY, INC.

Roselle, N. J.

Now—J-M Chempac-Interlocked Packing combines both "Teflon" and asbestos protection

Johns-Manville now introduces Chempac®-Interlocked Packing, with three important advantages for service in chemical and process equipment. Interlocked provides the excellent sealing and heat resistant qualities of asbestos. It is braided by the unique and exclusive J-M method, so that the asbestos yarns are securely interlocked and cannot come apart in service. And it is treated with chemically inert Teflon*, which is almost universally resistant to chemical and solvent action.

Chempac-Interlocked can be used to pack pump rods or shafts, rotary filters, mixers and similar apparatus handling strong acids, alkalis, caustic solutions and many other reagents at temperatures to 500F.



Other J-M Chempac Packings and Gaskets for the Chemical and process industries

J-M Chempac Packings in coil, spiral and ring form. Made of asbestos, treated with Teflon, they are available in types for caustic, acid, chlorine and solvent service.

J-M Chempac Gaskets with Asbestos-Teflon base. They have high mechanical strength and heat resistance, with excellent sealability at low bolt stresses.

J-M Chempac Folded Gaskets designed for glass lined equipment. Asbestos-Teflon base gives them high sealing effectiveness against a wide range of chemicals.

J-M Chempac Spirotallic Flange Gaskets for perfect sealing in high temperature and pressure service, constructed of interlocked plies of metal and Teflon-Asbestos.

*Trade Mark of DuPont Tetrafluoroethylene resin

Free Folder gives complete details on Chempac-Interlocked and other J-M Chempac Packings and Gaskets for the chemical and process industries. For your copy of folder PK-80A write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

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Johns-Manville PACKINGS & GASKETS

in vacuum processing . . .

PLAN FOR TOMORROW,

today!

Whether you need vacuum for laboratory, pilot plant, or production, it's wise to choose Kinney . . . the high vacuum pump with the capacity and stamina to handle tomorrow's vacuum requirements today. A Kinney Pump gives you rugged durability plus all-around versatility . . . it stays young and useful even after years of steady service, and is easily shifted from one assignment to another.

Kinney offers nine single stage and four compound vacuum pump models, and the new mechanical booster pump . . . 14 tried and proven answers to your industrial vacuum problems. Kinney also offers highly specialized vacuum experience to help you meet the challenge of your ever-expanding vacuum needs.

Write today for Catalog 425 . . . or tell us about your vacuum processing requirements. Kinney District offices in Boston, New York, Philadelphia, Cleveland, Chicago, and Los Angeles are all competently staffed to discuss vacuum with you. Los Angeles office carries complete stock and has full service facilities.

See us at Booth 333-335-339 at the Chemical Show.

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THE NEW YORK AIR BRAKE COMPANY
3551 WASHINGTON STREET • BOSTON 30 • MASS.
INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N.Y.

Please send catalog 425 describing the complete line of Kinney High Vacuum Pumps.

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Company.....
Address.....
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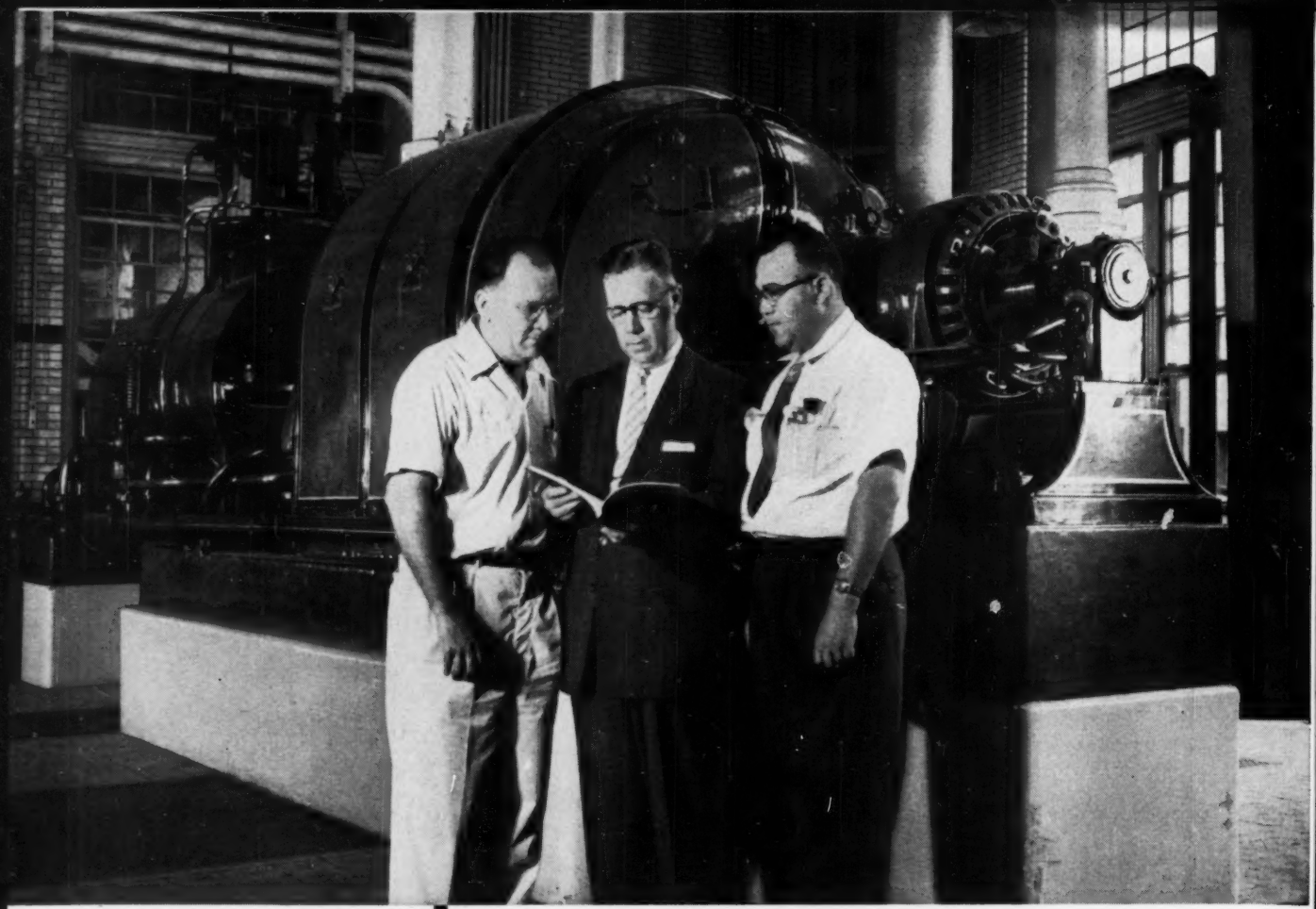


E. A. Hamann (left), Power Generation Engineer and Robert Best (right), Superintendent of Utilities, go over lubrication records with Bill Schall, Standard Oil lubrication specialist. Bill Schall has been providing technical sales service to Standard Oil customers since 1943. Bill is an engineer with a B.S. in engineering from Georgia Tech., and a graduate of Standard's Sales Engineering School. Customers of Bill's find this experience and background pay off *for them.*

Anheuser-Busch still using same turbine oil after 24 years

...NONPAREIL

For more than 24 years the Anheuser Busch Brewery, St. Louis, Mo., has been operating two 3,000 kw., turbines using NONPAREIL Turbine Oil. Three more turbines added to the system in 1940, '48 and '51 have also used NONPAREIL since beginning operations. The reason for choosing NONPAREIL is clear; it is guaranteed for the life of the turbine.

Since the initial installation, Anheuser Busch has not had to replace a NONPAREIL Turbine Oil fill. Neutralization number is always far below 0.15 mg. KOH/g., the degree of acidity Standard Oil guarantees NONPAREIL will not exceed. At nearly all times neutralization number is on the order of 0.03 mg. KOH/g. (See chart).

In all these years, oil systems have remained clean. There has been no problem of oil acidity in any of the five turbines. The delicate art of brewing world famous Budweiser goes on without concern over power failure due to lubrication failure.

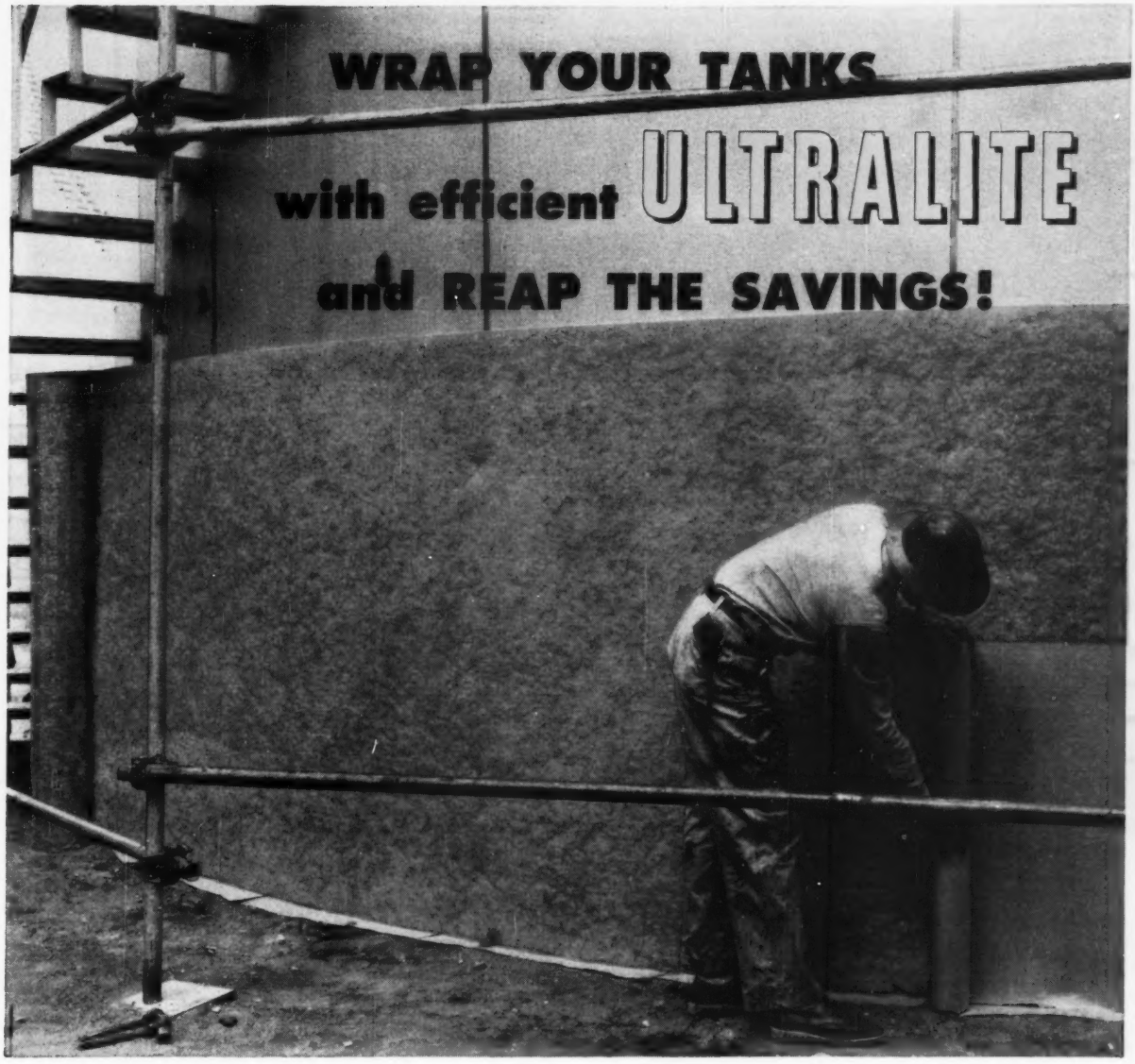
Like to know more about NONPAREIL and its possible use in your turbines? In the midwest call your nearby Standard Oil lubrication specialist. Or, contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Anheuser-Busch Turbine Lubrication Record

Generator Capacity	Start up and NONPAREIL Installation Date	Date of Last Oil Analysis	Neutralization Number
3,000 kw.	Oct. 2, 1930	July 20, 1954	0.03
3,000 kw.	Oct. 2, 1930	July 22, 1954	0.02
2,500 kw.	June 10, 1940	July 20, 1954	0.03
7,500 kw.	Jan. 2, 1948	July 22, 1954	0.03
7,500 kw.	July 26, 1951	July 22, 1954	0.01

STANDARD

STANDARD OIL COMPANY
(Indiana)



Quick as a flash, lightweight rolls of Ultralite glass fiber insulation can be run around tanks, vats and vessels — and that's more than *half* the battle in your war on insulating costs. The wider the roll, the quicker the job is done, and Ultralite is available in rolls up to *10 feet wide!*

Consider the advantages of this New Way vs. the Old Way on a tank of about 4,000 sq. ft., like the one pictured. To do the job with Ultralite required just 4½ rolls, 150' long and in this case, 6' wide. One man can easily carry such a roll. One man can easily apply Ultralite. But, if you were to use individual insulation bats, 24" x 96", you'd need 250 bats . . . and how many men would you say? And while you're figuring the saving, don't forget that you need twice as many welded mounting clips to apply bats as you do to apply Ultralite blankets.

Versatile and efficient Ultralite has other advantages, too, as insulation for all types of large heated equipment. It's resilient — not rigid — so that it can't crack under normal expansion and contraction. Its superior thermal efficiency means substantial heat savings over the years, and of course, Ultralite is as permanent as glass itself.

Next time, use Ultralite. It *figures.*

WRITE TODAY FOR "HOW-TO-DO-IT" DETAILS AND SPECIFICATIONS

GUSTIN-BACON *Manufacturing Company* GUSTIN gb BACON

Thermal and acoustical glass fiber insulations • Pipe couplings and fittings • Molded glass fiber pipe insulation

252 W. 10th ST., KANSAS CITY, MO.

"I know how we can correct those low-voltage problems"

"You know the trouble we've been having with low voltage out near the ends of those long plant feeders. It's caused poor motor performance by reducing starting and pull-out torque. The motors run hotter—and that shortens their life. We're getting poor welds, too, because voltage fluctuations interfere with the spot welders.

"Well, this little book tells how to correct this condition. All we do is install Westinghouse capacitors near the ends of the feeders. They're simple devices. They consume no power but supply the 'reactive power' required by our motors.

"Reactive power is the root of our problem. All rotating machines require it in addition to working power. To supply it, we've needed high current in those long feeders. Line drop has caused the low-voltage condition. Capacitors will solve the problem by reducing feeder current. This will raise the voltage level, reduce line drop, and restore normal motor performance."

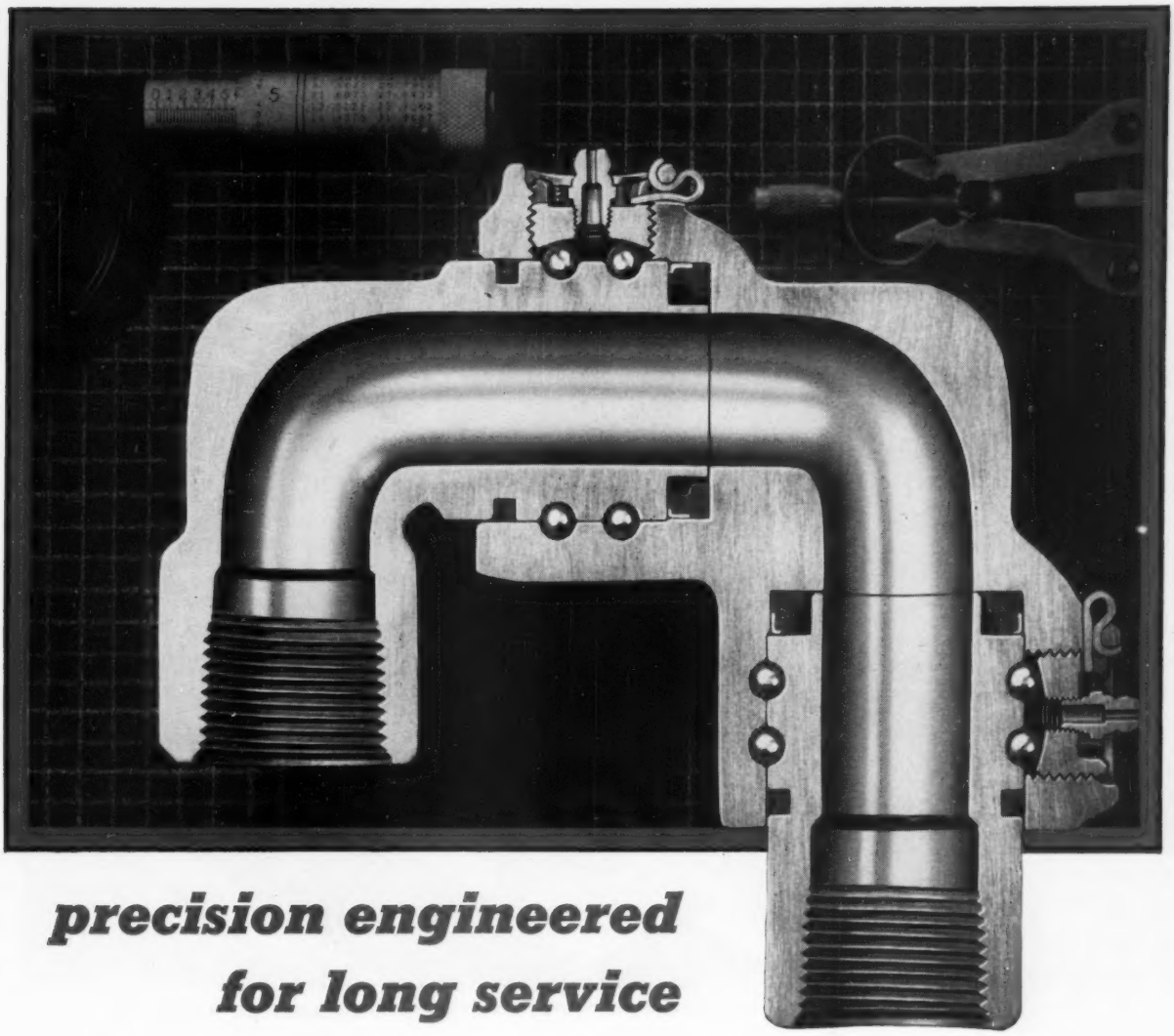
Capacitors relieve power system

"Capacitors will increase the capacity of all our plant circuits. Thus, we can add new machines on any circuit—without changing transformers or tearing up our plant to install heavier conductors.

"We ought to look into this right now. Capacitors are a low-cost solution to our low-voltage problem. They'll help prevent overloads on the circuits supplying motor loads. Best of all, they'll save us money—on power losses and on lower power rates through improvement in our power factor."

MR. READER: Is low voltage a problem in your plant? Write now for this free literature which shows how Westinghouse capacitors improve voltage regulation, boost plant circuit capacity, release transformer capacity and make it possible to get lower power rates through power factor improvement. Write for B-3966 and DB 49-110-1, Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. J-60850-A

YOU CAN BE SURE...IF IT'S
Westinghouse



precision engineered for long service

CHIKSAN Ball-Bearing Swivel Joints are precision engineered like a fine watch to give unlimited flexibility and unlimited service in the conduct of fluids, gases and liquids.

CHIKSAN is the originator and largest exclusive manufacturer of ball-bearing swivel joints in the world today.

CHIKSAN produces packing designs for specific service requirements, assuring constant torque at any given pressure.

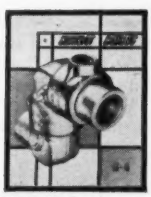
CHIKSAN has acquired a world-wide recognition for highest quality of product and lowest maintenance costs.

CHIKSAN has over a quarter of a century of "know-how" in the design, manufacture and successful scientific application of ball-bearing swivel joints in industry.

CHIKSAN offers the widest range of styles, sizes and pressures available for every major industrial use today.

CHIKSAN has complete nation-wide coverage of its products and applications by qualified field service engineers.

CHIKSAN will custom engineer for you the solution to any problems involving the transport of fluids, gases and liquids.



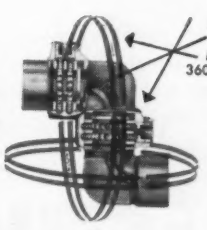
Write CHIKSAN for latest INDUSTRIAL CATALOG—G-4 Dept. 120

Supply and Service of CHIKSAN Ball-Bearing Swivel Joints is always as near as your telephone.

The Flow of Enterprise Relies on

CHIKSAN

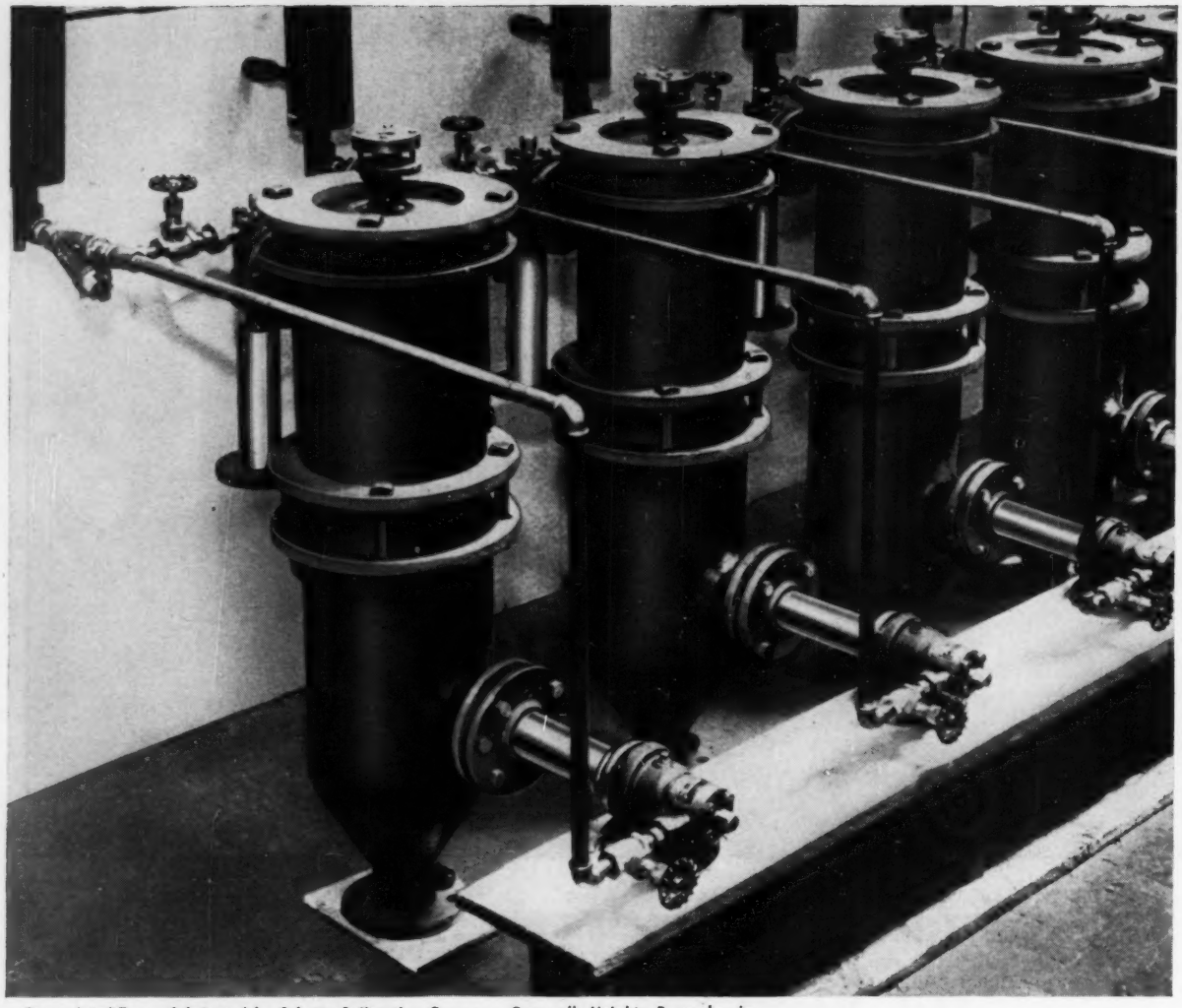
Ball-Bearing Swivel Joints



CHIKSAN Ball Bearing Swivel Joints are THE NEW TOOL of Modern Industry with full 360° rotation in 1, 2, and 3 planes. Over 1,000 different types, styles, and sizes have been developed for pressures and services from 28" vacuum to 15,000 psi and for temperature ranges from minus 70° to a plus 500° F. with packing materials for each specific service.

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 3, Illinois • Newark 2, New Jersey

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Co., Brea, Calif.; Newark 2, N. J. • Chiksan of Canada Ltd., Edmonton, Alta.



Steam jet diffusers fabricated by Schutte & Koerting Company, Cornwells Heights, Pennsylvania.

TITANIUM cuts replacements 90%

These "steam jet diffusers" create a process vacuum in a large scale chemical operation. And they used to be replaced every three months.

High-velocity steam and dilute hydrochloric acid formed a natural environment for cavitation corrosion and erosion—quick death for the cast iron diffusers originally used. Several alternate corrosion-resisting materials were tried, without success, until REM-CRU titanium was specified.

The first titanium diffusers were placed in service 2½ years ago. They are still going strong, with no sign whatever of corrosion or erosion—*a 1000% improvement in service life, and more to go.*

Titanium's remarkable properties explain why such improvements are possible. First, titanium is immune to attack by chlorides—and an unusually wide spectrum of other corrosives. Furthermore, it resists erosion by high-velocity fluids—and abrasion, shock and fatigue stresses. It is as strong as steel, at about half the weight, which means significant reduction in volume—and cost—of material required.

Investigate REM-CRU titanium for yourself whenever you find too-frequent metal failures under corrosive conditions. Remember, it is available in all sizes and grades—and in substantial quantities at the lowest prices ever, thanks to REM-CRU's expanded facilities and recent price reductions. So find out more about titanium—call in a REM-CRU engineer today.

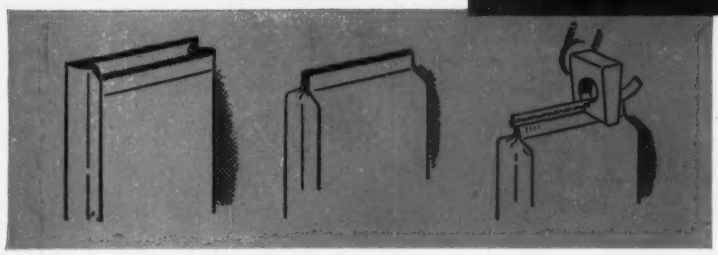
To keep abreast of the latest developments on this vital metal, write to Dept. C-10 for the Rem-Cru Review—a free periodical presenting the latest technical data on titanium alloys.

REM-CRU TITANIUM

REM-CRU TITANIUM, INC., MIDLAND, PENNSYLVANIA

Our pioneering pays off in profits for you

BAGPAK — **PREFORM** MULTIWALLS



It's the Crease that does it!

- **Makes bagtop forming easier**
- **Speeds Bag closing**
- **Insures better filling**
- **Produces a better-looking package**

Bagpak, the first to introduce multiwall bags to many industries, then improved them with the PREFORM top for easier, time-saving uniform closing. Now the PREFORM feature at the bottom means easier opening for faster, more complete filling.

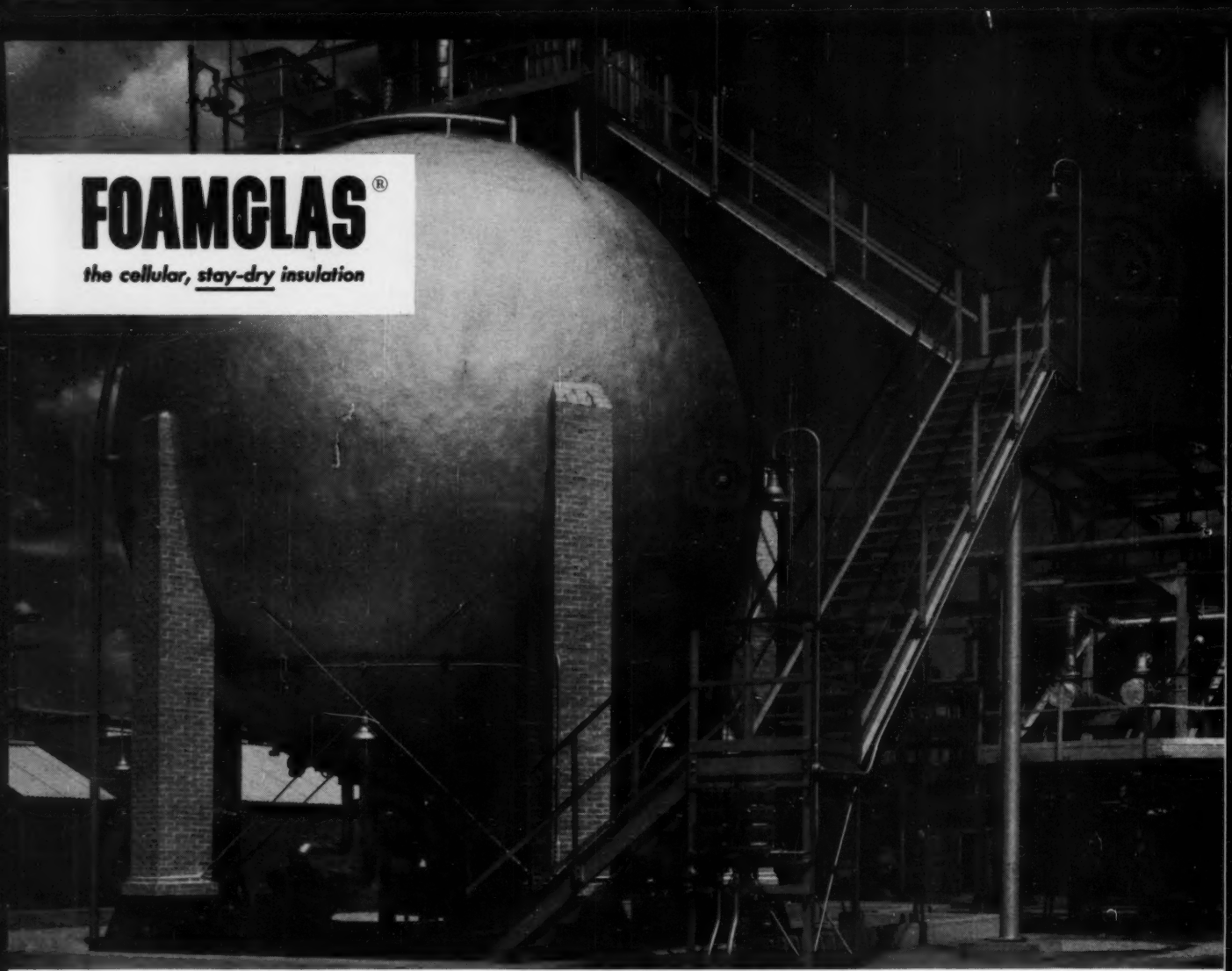
You profit because your bags are filled, formed and closed in record time. You package bigger tonnage daily—and there's no waste.

Asking for complete information and prices places you under no obligation. Just write today to Dept. K-19

International Paper COMPANY

BAGPAK DIVISION

BRANCH OFFICES: Atlanta · Baltimore · Boston · Chicago · Cincinnati · Cleveland · Dallas · Denver · Des Moines · Detroit · Kansas City, Kansas · Los Angeles Minneapolis · New Orleans · Philadelphia · St. Louis · San Francisco · IN CANADA: The Continental Paper Products, Ltd., Montreal, Ottawa, Toronto



Insulation Contractor: Combustion Equipment & Insulation Co., Cleveland, Ohio

SOHIO gets efficient desalting because . . .

Spillage-proof FOAMGLAS insulation stays effective to hold precise temperature

Efficient electric desalting to remove salts and other impurities from crude charging stocks demands precise temperature control throughout the process. The influent temperature (180° F to 220° F depending on viscosity of crude) must be held constant until effluence. Since there's no exchange of heat inside the sphere, it must be insulated very effectively.

For six years Standard Oil Company (Ohio) has maintained peak desalting efficiency by insulating their spheres in Cleveland, Lima and Toledo with FOAMGLAS. This unique cellular glass insulation benefits SOHIO three ways:

1. **Spillage-proof,** moisture-proof FOAMGLAS retains its insulating value . . . avoids fire hazard.
2. **Easy-to-apply** FOAMGLAS blocks are lightweight but very strong, readily applied to sphere, eliminating insulation supports.
3. **Effective insulation** holds temperature required for electric field to break continuously the water and oil emulsion. It also prevents temperature drop near vessel wall . . . avoids thermal currents which would interfere with process.

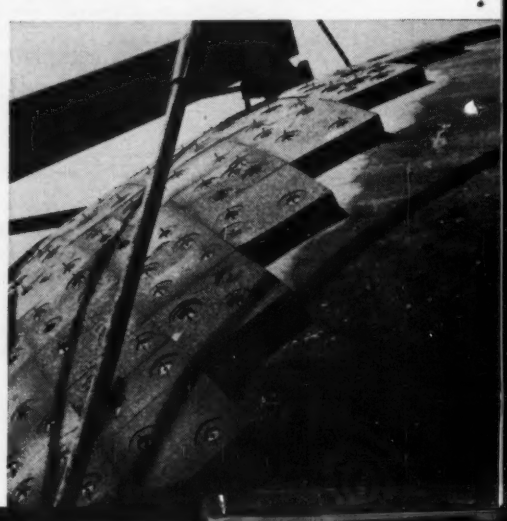
You'll benefit too by using this unique insulation. For more facts please write for booklets on FOAMGLAS for piping or tanks and equipment.

Pittsburgh Corning Corporation

Dept. H-105, One Gateway Center
Pittsburgh 22, Pennsylvania
In Canada: 57 Bloor St. W., Toronto, Ontario

Visit our booth at the CHEMICAL SHOW, Philadelphia, December 5th to 9th

2" thick FOAMGLAS blocks cut to 12 x 12 size were laid diamond shape on SOHIO'S desalter sphere in Toledo. Two Nelson studs were welded through each block and secured with recessed Tinnerman speed clips. After asphalt cutback (Insulmastic 4010)—glass fabric—cutback application, the surface was finished with an asphalt base aluminum paint.



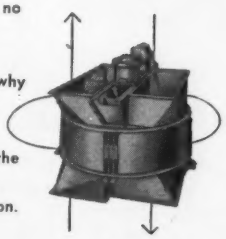
reduce slag

stay on stream at top capacity months longer with the Ljungstrom® Air Preheater

HOW FAST IS "WRITE OFF"?

By cutting turnaround time alone, the Ljungstrom means major savings for you. When you take the other Ljungstrom advantages into account—up to 20% fuel saving . . . more economical furnace design, with no need for convection surfaces . . . burns many fuels you used to throw away . . . consistently higher through-put . . . higher product quality—you can see why a Ljungstrom is paid out in just a few months.

For more complete details on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits attainable in fuel burning equipment—call or write The Air Preheater Corporation.



Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

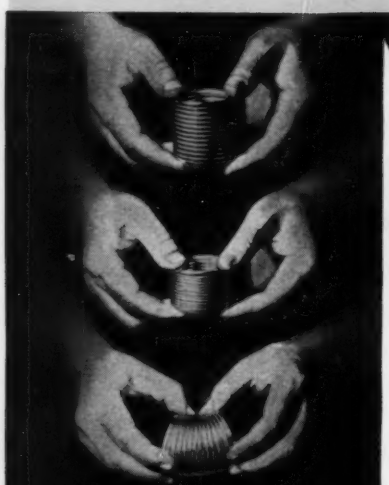
Slag—primary cause of reduced capacity—can be substantially reduced by the Ljungstrom Air Preheater.

That's because preheated air mixes more thoroughly with fuel. The result is better combustion . . . and less slag-forming material present in the furnace. Oil tubes stay cleaner . . . stills stay on stream at top capacity for months longer. As an example, one pipe still in an eastern refinery dropped from 16,000 barrels a day to 12,000 because of slag. Now, with a Ljungstrom and modern high-temperature burners, the still operates continuously at 18,000/20,000 barrels.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

FULTON SYLPHON

BELLOWS HEADQUARTERS,



Seamless Metal Bellows

The Sylphon Bellows was originated by Fulton Sylphon over 50 years ago. Its unique one-piece expansible and collapsible design is used widely for diaphragm effects, flexible connections and expansion chambers.

All Types, Sizes and Metals

Fulton Sylphon Bellows are all designed to specific customer requirements. They are furnished in a limitless number of sizes, a complete range of types and metals and with many different reaction characteristics.

On-Call Engineering Service

Fulton Sylphon Bellows Engineers are strategically located in all industrial areas of the country. This "near-by" service is on-call to help you determine the right bellows metal, correct bellows charge and most economical design for your specific application.

U.S.A.

For the conversion of pressure effects into controlled movement, the operation of valves and switches in response to temperature change, the absorption of thermal or pressure expansion or the absorption of vibration—a seamless metal bellows may be your best design solution. The best way to find out, is to consult a Fulton Sylphon engineer. He'll focus more than 50 years experience in bellows engineering on your problem.

Mr. Controls

Robertshaw-Fulton
CONTROLS COMPANY
FULTON SYLPHON DIVISION

Assemblies and Complete Devices

By purchasing complete bellows assemblies and devices rather than buying bellows units, many manufacturers achieve significant production economies. Fulton Sylphon is singularly equipped to design and produce complete assemblies at low cost.

On-Time Delivery • No Delays

Fulton Sylphon's mass production facilities are geared to good service. Exceptional quality control techniques often eliminate any need for customer's in-coming inspection. Customer service and shipping follow-through assure on-time delivery without costly delays.

BASIC BELLOWS ENGINEERING and ways Fulton Sylphon can serve you are described in this 32 page Bellows Catalog. It makes profitable reading . . . use the handy coupon to get your free copy.

FULTON SYLPHON DIVISION
Knoxville 1, Tennessee

☐ Please have a Bellows Engineer call me for an appointment.

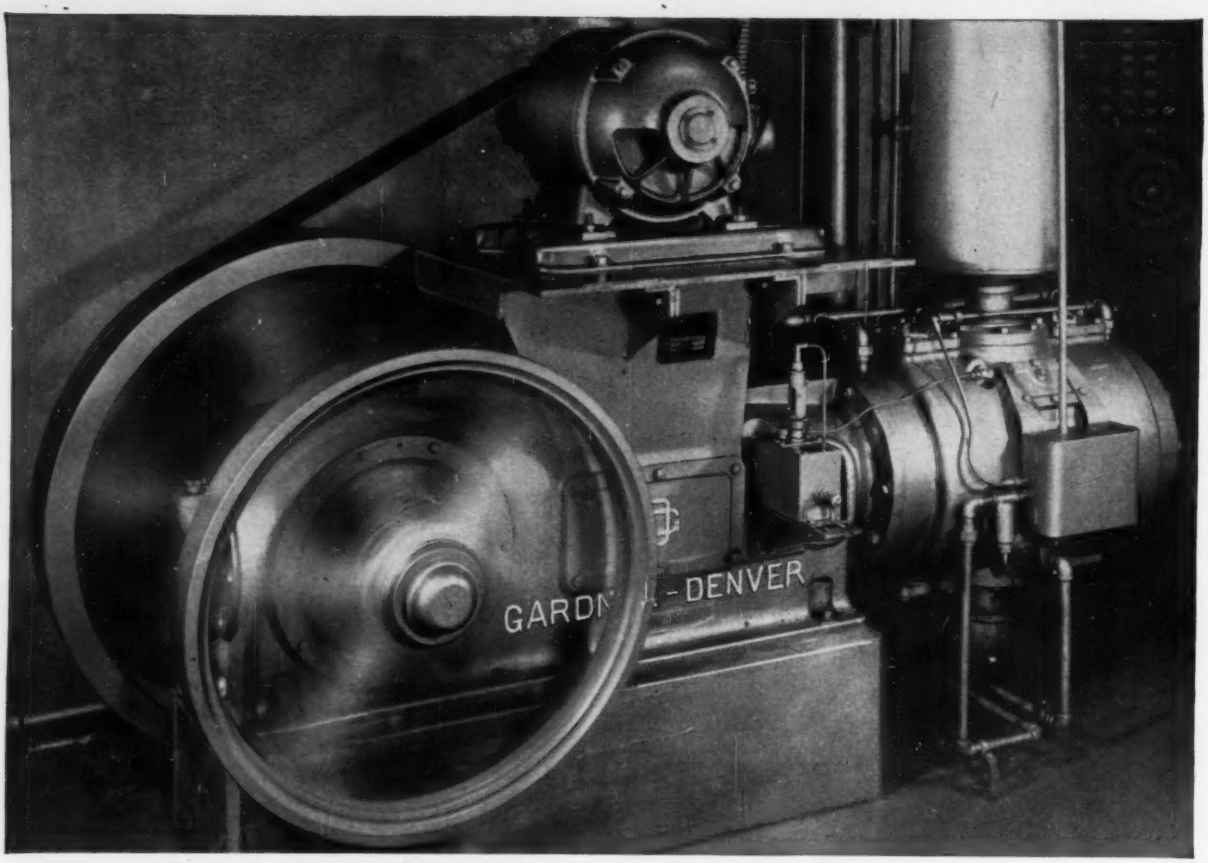
☐ Send me Bellows Catalog No. CE-1400

Name_____

Company_____

Address_____

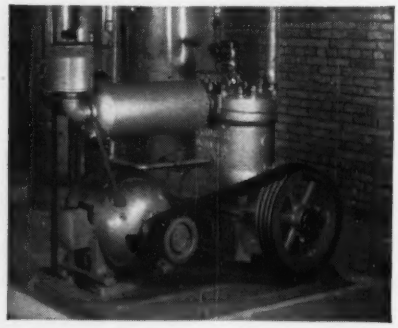
City_____ State_____



Model RX — 89 to 1292 c.f.m. Bulletin HAC-40.

MORE GARDNER-DENVER HELP FOR YOU IN THIS AGE OF AIR POWER

Model AA — 32 to 183.6 c.f.m. Bulletin AA-6.



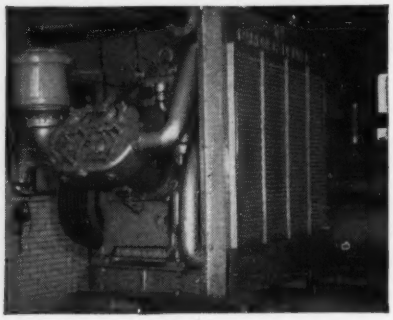
✻ Expert help in choosing the right size and type air compressor for your plant.

✻ Pointers on compressor care and maintenance to help you obtain the full efficiency of Gardner-Denver quality.

✻ Application suggestions for utilizing low-cost air power from Gardner-Denver compressors.

GARDNER-DENVER Since 1859 KELLER TOOLS

Model WB-142 to 686 c.f.m Bulletin WB-10.



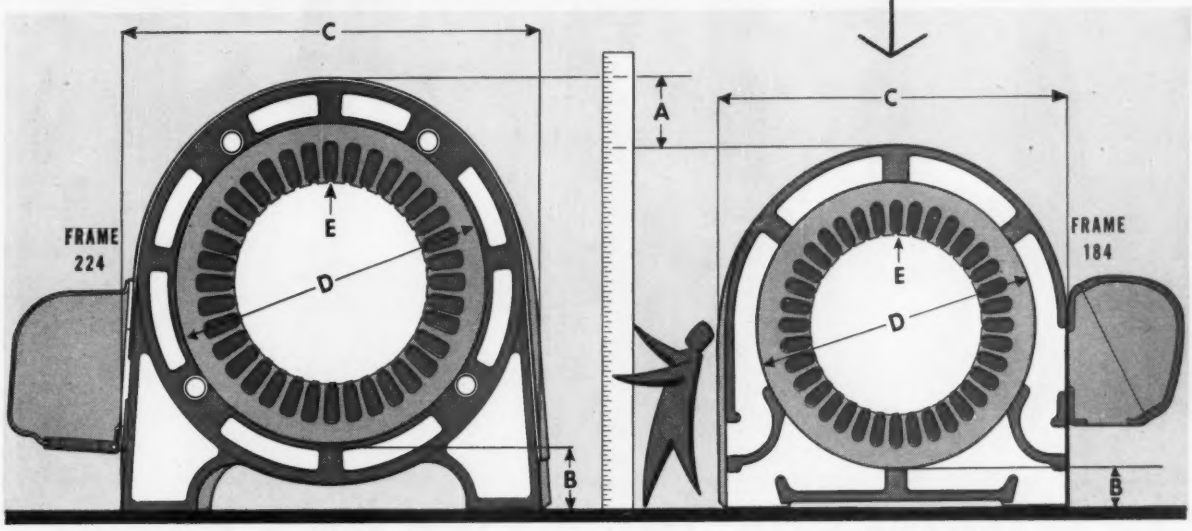
GARDNER-DENVER

THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

THE NEW U.S. UNICLOSED MOTOR

saves 46% in space*



PREVIOUS DESIGN — NEW DESIGN

COMPARISON

A — Over-all height reduced
B — Stator closer to mounting surface
C — Over-all width reduced
D — Approx. same punching O. D.
E — Same number of slots

* EXAMPLE — 2 h.p., 4-pole
Previous 224 Frame — 1663 cu. in.
New 184 Frame — 891 cu. in.
SAVING — 772 cu. in. or 46%

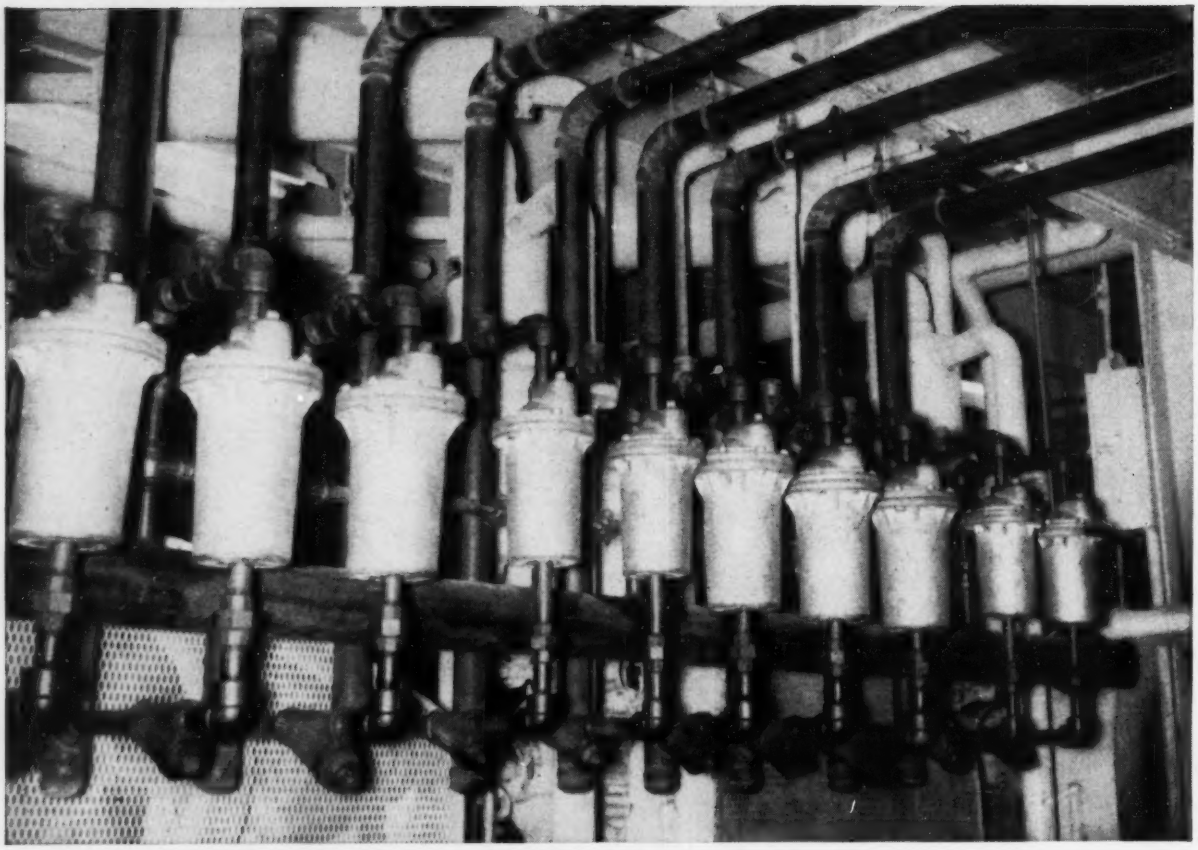
More Horsepower per cubic inch

Saving in space of 46% for the 2 h.p. size, in comparison with previous NEMA dimensions, is typical of the ratings in the new U. S. Type H Uniclosed motor. Improvement of insulation, advanced electrical design, closer tolerances, all contribute to development of maximum horsepower within the least cubical space. Many other exclusive U. S. features, such as asbestos-protected windings, Lubriflush transverse lubrication, solid cast-iron frame and normalized castings, also add longer life and more efficient power.

Mail Coupon for informative full-color 12-page Type H Bulletin

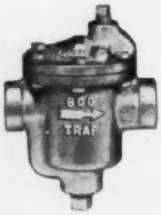
U. S. ELECTRICAL MOTORS, INC. CE-10
P.O. Box 2058, Los Angeles 54, Calif., or
Milford, Conn. Send Type H Bulletin No. F-1856

NAME _____
COMPANY _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____



Tip on Choosing Steam Traps: Run Tests with a Pyrometer

Bottom inlet-top outlet traps in six sizes, ½" to 2" connections; 950 to 20,000 lbs/hr capacity.



Side inlet-side outlet traps in five sizes, ½" to 1¼" connections; 680 to 6700 lbs/hr capacity.

Integral strainer traps in three sizes, ½" and ¾". Cost less than trap and separate strainer, save fittings and labor.

A common problem—Traps on Rogers spray driers at Rochester Dairy Company, Rochester, Minn., required frequent servicing—used up about two months of one man's time annually. And, then, within about 30 days after trap servicing, drier temperatures would be 100 degrees below steam temperature. Nobody has to put up with such trap troubles!

Take a tip from this solution!—Henry T. Maass, Building and Utility Supt., took action. He ran extensive pyrometer tests on his driers, using different makes of traps.

100° hotter!—The driers are now equipped with Armstrong inverted bucket steam traps. Temperatures correspond to steam pressure—100 degrees hotter than before. Maintenance?—negligible. Rochester carries $63.31 of Armstrong trap parts in maintenance store against $873.52 in parts for another make of traps that haven't been replaced yet.

Moral—A small investment in Armstrong steam traps can make a world of difference in performance of production equipment and in cost of maintenance. Call your local Armstrong Representative, he has the products and the experience and the ability to be of real assistance.

FREE CATALOG

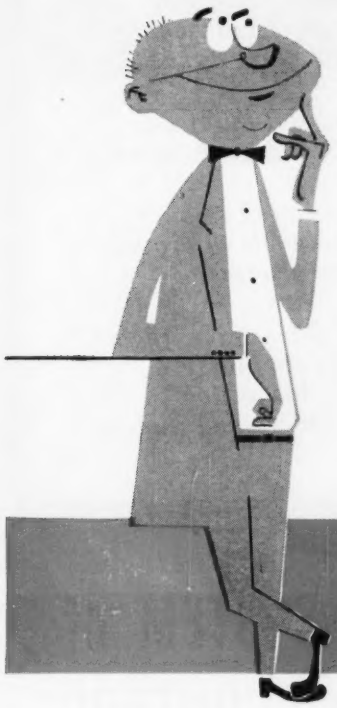
The 44-page Steam Trap Book is "the handbook of steam-trapping". Selection, installation, maintenance, capacities, data, prices, tables, charts, useful material—yours for the asking without any obligation. Also see data in Sweets or Chemical Engineering Catalog.

Armstrong Machine Works
858 Maple Street, Three Rivers, Michigan

Application Engineered

ARMSTRONG STEAM TRAPS

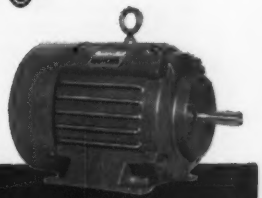
BEARING TROUBLES?



NO SIR! Not with new Reliance Motors and METERMATIC .... the

Automatic Grease Monkey

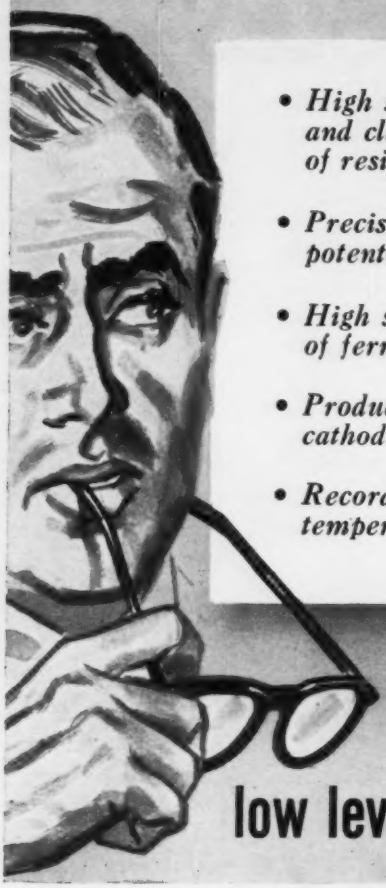
I found out how to put an end to burned out bearings from the Reliance Metermatic Bulletin, A-2406. Why don't you write for one? A-1499



RELIANCE ELECTRIC AND ENGINEERING CO.

Cleveland 10, Ohio • Offices in Principal Cities

These or similar problems puzzling you?



- *High speed inspection and classification of resistive elements*
- *Precision control of minute potentials and currents*
- *High speed inspection of ferromagnetic materials*
- *Production testing of cathode ray tube brightness*
- *Recording extremely low temperature differentials.*
- *Continuously recording rate of temperature change in jet engine test stands*
- *R.M.S. regulation of a-c oscillators and generators*
- *Multiplication of two a-c or d-c signals to provide a precision product*
- *Precision low power factor measurements for production inspection of transformers and motors*

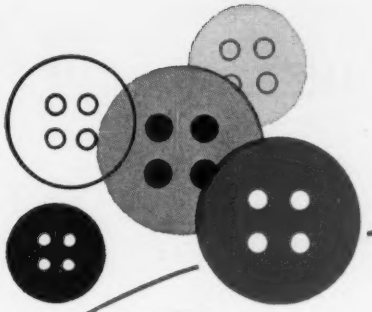
The INDUCTRONIC® SYSTEM of low level MEASUREMENT and CONTROL

Model 1475 Multi-Range Inductronic D-C Amplifier provides amplification of a complete span of direct current and voltage ranges of either polarity with no sacrifice in fundamental accuracy or speed. Has seven current ranges, from 10 to 1,000 microamperes — and ten voltage ranges, from 1 to 1,000 millivolts. All ranges immediately available by the turning of a switch; and an additional seventeen ranges become available by a knob adjustment which changes the instrument from zero left to zero center. Accuracy 1%. Accessories such as recorders and additional indicators can be inserted in the output to a total of 5,000 ohms without affecting accuracy or calibration.

Practical solutions to the above, and many other problems of low-level measurement and control have been supplied by the WESTON Inductronic System . . . an entirely *different* method of d-c amplification. Utilizing the deflection of a permanent magnet moving coil system, it converts extremely low-level d-c to a proportionate a-c signal and amplifies it to a *usable degree* . . . then reconverts to a d-c level. The system operates at a frequency of 200 KC, and provides a high order of sensitivity, accuracy and speed. And because of circuit simplicity, the system is stable and virtually maintenance free. To learn how you can apply the Inductronic System in research or production, call your nearest Weston representative, or write direct for bulletin B-36-B.

WESTON *Instruments*

WESTON ELECTRICAL INSTRUMENT CORPORATION, 614 Frelinghuysen Avenue, Newark 5, New Jersey



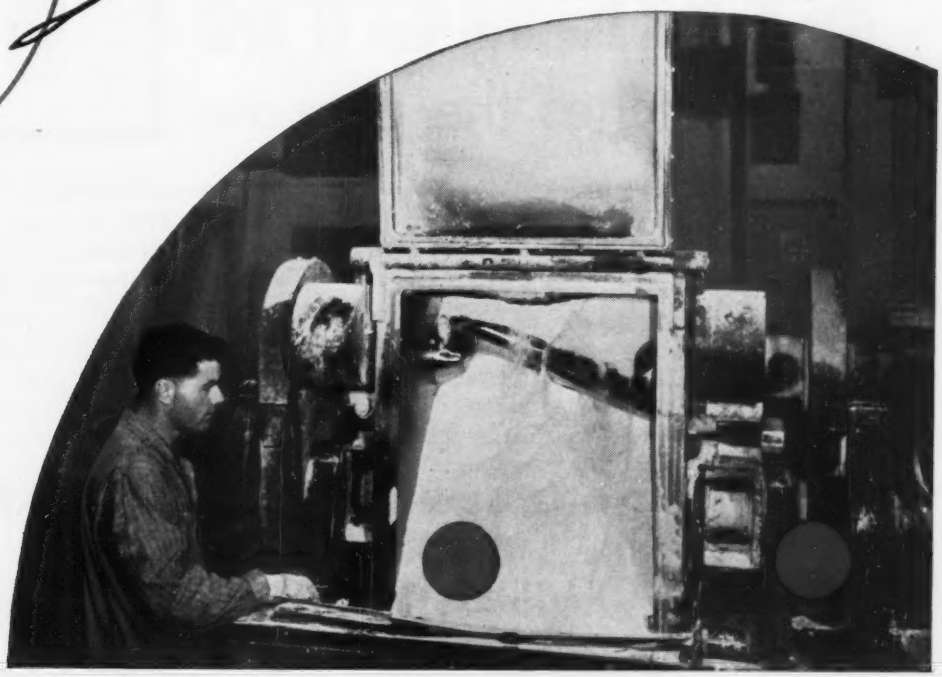
BAKER PERKINS
SIZE 14 JNM2 UNIVERSAL MIXER
uniformly blends special vinyl compounds for Auburn Button Works, Inc., Auburn, N.Y.

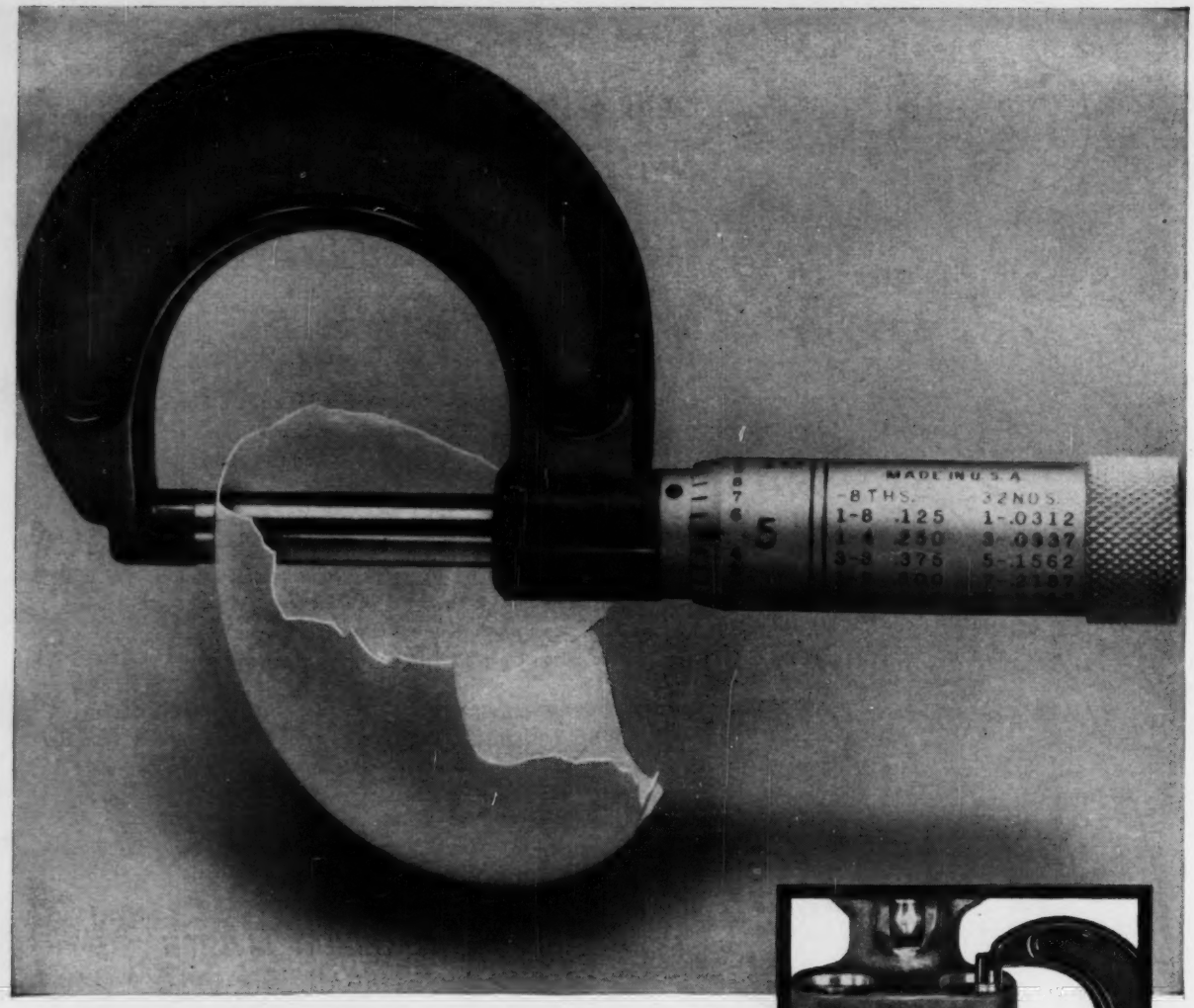
As an intermediate processor of raw materials for plastics fabricators, the Extrusion Division of Auburn Button Works in Auburn, New York, compounds and blends a wide variety of special vinyl plastic mixtures for its many customers. Thorough mixing and intensive kneading of the materials is necessary to insure a uniform blend with high tensile strength, good surface quality, retention of heat and light stability and other characteristics important in the finished extrusion. To obtain these characteristics, Auburn employs a specially designed Size 14 BAKER PERKINS JNM2 Universal Mixer with a working capacity of 50 gallons and a total capacity of 75 gallons. This machine is equipped with a trough shell of #304 stainless steel and is jacketed for 80 lbs. steam pressure. It has cast sigma blades with dispersion faces, cored for steam, and is driven by a 20 h.p., 900 rpm. motor.

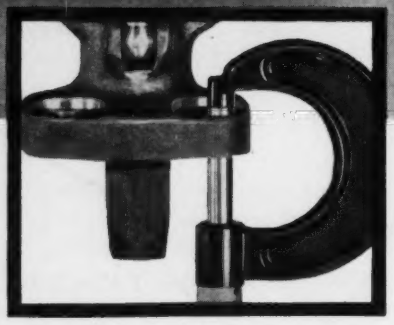
BAKER PERKINS Universal Mixers are adaptable to virtually every mixing and kneading operation from very light to heavy duty, handling mixtures ranging in consistency from dry powders to stiff plastic masses. For complete information about Universal Mixers and other B-P equipment for the chemical processing industries, consult a BAKER PERKINS sales engineer or write us today.

289

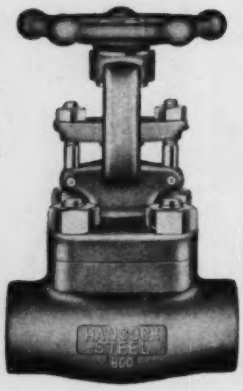
BAKER PERKINS INC.
CHEMICAL MACHINERY DIVISION
SAGINAW, MICHIGAN







STRENGTH
that matches the purpose



THE BONNET FLANGES on the Type 950 Hancock Steel Gate Valve combine compactness with rugged strength *where strength is needed most.* Flange thickness and bolting provide sturdiness that can withstand more than ten times the rated pressure of the valve. Butting of the flange faces eliminates every possibility of bending and distortion.

In revalving old, or installing new process and power piping systems, the enduring strength of Type 950 Hancock Steel Gate Valves always proves there is no substitute for the economy of quality. Get complete facts. Phone your Industrial Supply Distributor today.

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U.S.I. CHEMICAL NEWS

Sept.-Oct. ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1955

TWO NEW CHEMICAL PLANTS LOCATE AT ASHTABULA, OHIO

U.S.I. Offers 3 Series of Polyethylene Resins

U.S.I. polyethylene grade numbers have been realigned into three well-defined groups. Resins in the 100, 200 and 300 series are available from the plant at Tuscola, Ill. and from warehouse points at Anaheim, Cal.; Chicago, Ill.; Cincinnati, O.; Jersey City, N. J. and New Orleans, La. They are:

PETROTHENE* 100—*Tubular film extrusion* resin having good transparency; medium flow, for *blow molding.*

PETROTHENE 110 — *Tubular and sheet film extrusion* resin having good transparency; superior slip properties; medium flow.

PETROTHENE 200 — All purpose resin for general *molding and extrusion, film,* or *small parts.*

PETROTHENE 201 — Medium to High flow resin for *molding, extrusion, paper coating, blow molding.*

PETROTHENE 202 — *High flow resin* for *injection molding, large parts, coating applications.*

PETROTHENE 203 — Medium to High flow resin for *injection molding* and *paper coating.* Stiffer than "202" in molded part.

PETROTHENE 210 — *Sheet film extrusion resin* (Type 200) having good transparency; exhibiting superior slip properties.

The Petrothene 300 series is especially adapted to wire covering and electrical insulation applications.

Samples and property data on request.

*Trade Mark

Chemical PA's Discuss Purchase vs. Manufacture

Seven considerations in buying versus making custom chemicals were discussed at the June meeting of the Chemicals and Allied Products Buyers Group of the National Association of Purchasing Agents. D. B. Black, sales manager for fine chemicals at Dow, and the principal speaker, enlarged on the considerations of production set-up, equipment, time factors, man power, risks and capital.

Officers of the group, elected at the meeting, include: G. C. Fordyce (American Cyanamid) — General Chairman; S. E. Spencer, Jr. (William S. Merrell) — General Vice Chairman; R. G. Weigel (Eli Lilly) — Chairman, Pharmaceuticals and Fine Chemicals Section; J. W. McKinney (DuPont) — Chairman, Heavy and Industrial Chemicals Section; A. T. Ericson (Lederle) — Secretary; J. M. McNeil (Goodrich) — Treasurer.

January 24, in Chicago and January 31 in New York have been fixed as the dates for the next midyear meeting of the group.

Titanium and Fatty Alcohol Units Join Interrelated Chemical Complex; Local U.S.I. Sodium Source a Factor

The Great Lakes port of Ashtabula in Northeast Ohio is fast becoming one of the important chemical centers of the country. Over the past ten years the towers of half a dozen large process plants have come to dominate the skyline. The presence of U.S.I.'s metallic sodium plant at Ashtabula has catalyzed the growth of this new production area.

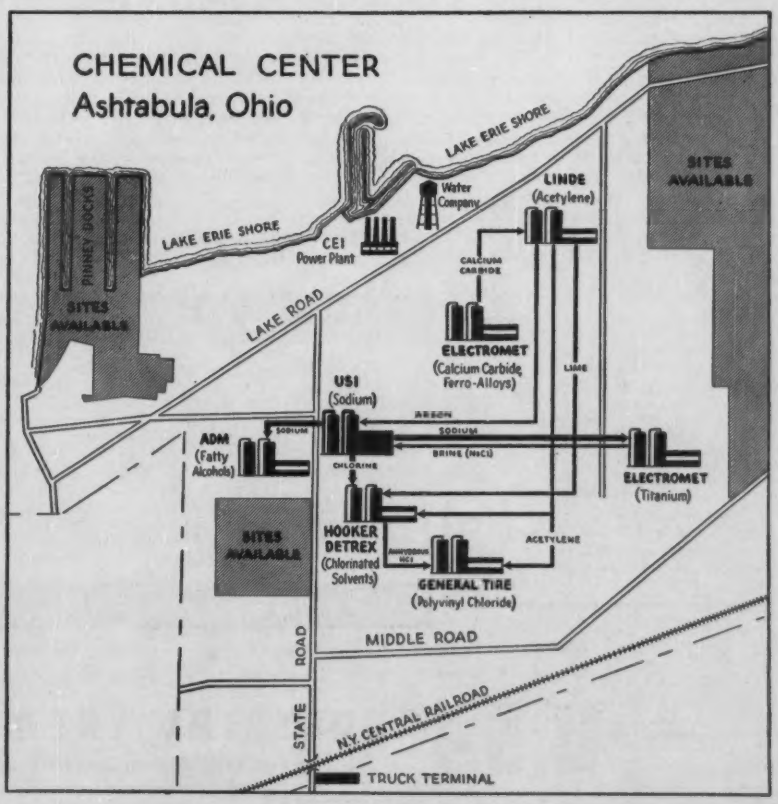
The chemical units relate, one to the other, in many ways. Products and by-products of one installation feed the process streams of the others. One plant's by-product material is another's source of supply.

Latest additions to the Ashtabula complex are Archer-Daniels-Midland's new fatty alcohol plant, and a new 7500-ton per year titanium plant now being built by Union Carbide's Electromet Division. They tie in with existing units in this manner:

Archer-Daniels-Midland's plant, which went onstream in June, uses U.S.I. sodium for reduction of fats and oils to saturated and unsaturated C_8 to C_{22} fatty alcohols, many of which have never been available before in commercial quantities. By-product caustic will be sold to chemical plants and other industry in the Northeast Ohio area. The availability of plentiful sodium from U.S.I. figured heavily in ADM's initial plans for entering the fatty alcohol business, and locating in Ashtabula.

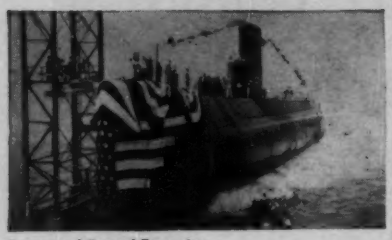
The U.S.I. sodium plant will supply metallic sodium to Electromet for reaction with titanium tetrachloride to produce titanium metal. Sodium chloride (brine) will be a by-product. The brine will be returned to U.S.I. for production of chlorine and more sodium. Due to rigorous specifications on titanium raw material purity, U.S.I. will use an atmosphere of pure argon in the sodium refining process, resulting in sodium of a purity not previously available commercially. The argon

MORE



Sept.-Oct. ★ **U.S.I. CHEMICAL NEWS** ★ 1955

Seawolf Launched — Sodium Vital to Her Atomic Power Plant



Courtesy of General Dynamics

On July 21 the second U.S. atomic submarine Seawolf slipped down the ways into the Thames River at Groton, Conn. The first atomic submarine Nautilus had preceded her by 6 months, but there is more than a time difference between the two vessels. Their nuclear power plants differ. While water was used as the coolant in the Nautilus, liquid sodium performs this function in the Seawolf. The coolant (in effect) transfers the heat generated by atomic fission within the reactor to the boiler, which turns it into steam for the turbine. On the advantages of the sodium system, we quote from the *New York Times* of Friday, July 22:

"General Electric — which built the Seawolf reactor — claimed these advantages for sodium:

"Because sodium does not boil, except at extremely high temperatures, the reactor coolant system does not have to be pressurized.

"Sodium is an excellent conductor of heat.

"Sodium, when its oxygen content is low, is noncorrosive to steels at operating temperatures.

"Sodium is a good electrical conductor: because of this it can be circulated by a magnetic pump that has no moving parts.

"Intermediate spectrum neutrons place fewer restrictions on the structural materials that can be used in the reactor core. For example, stainless steel can be used. This is because high energy neutrons are not readily absorbed by conventional metals."

Use of sodium as a heat transfer medium in atomic reactors takes advantage of sodium's *physical properties*. Most applications among U.S.I.'s sodium customers utilize the *chemical activity* of sodium.

Methionine Protects Against Irradiation

Recent reports from several researchers working independently in the United States and abroad have demonstrated the ability of methionine to protect against irradiation injuries. In the experiments, X-rays were used as the irradiation source and various laboratory animals were tested. The test animals were fed methionine prior to the exposure. Even under massive doses of irradiation the test animals remained relatively unharmed. On the other hand, the control animals showed skin lesions, some mortality and other typical evidences of irradiation damage.

This protective effect of methionine may be related to its previously reported ability to speed restoration of damaged tissue following burns, wounds and related skin injuries.

CONTINUED ASHTABULA

will be supplied by the Ashtabula plant of Linde Air Products Company, another Division of Union Carbide.

Location Advantages

The two new plants share with U.S.I. and other chemical enterprises in the area advantages of abundant water, land, labor and electric power. Easily available raw materials and markets plus transportation facilities by road, rail and water, have been important factors in the expansion of Ashtabula's chemical family.

In addition, the St. Lawrence Seaway, when completed, will add to the breadth of markets and greatly increase the number of raw materials easily and economically accessible to the area. In anticipation of the Seaway's coming, Ashtabula is increasing dock area by 40%, and expects to increase the harbor depth to 25 feet.

In every direction U.S.I. and its Ashtabula neighbors are preparing for a busy time to come on "Lake Erie's Chemical Shore."

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

A new silicone rubber remains flexible at 600°F for 150 hours or longer. Other characteristic properties are unaffected. Suggested for kitchen oven door seals and parts for hot materials handling equipment in industry. **(No. 1110)**

A new melamine-type resin for the paper trade bolsters tensile and wet burst strength. It also improves dry Mullen, wax pick, freedom from lint, dry stiffness, wet rub resistance, internal sizing and folding endurance. **(No. 1111)**

Simple new formula for estimating methionine requirements in broiler rations, plus wall chart giving methionine content and energy levels of common feedstuffs, are now available to feed manufacturers. **(No. 1112)**

An improved method for water-free hydrazine by azeotropic distillation has been described. The process yields anhydrous material directly, avoiding the costly two-step process necessary in previous conventional methods. **(No. 1113)**

A new, nonfoaming wetting and rewetting agent has been developed for exceptionally high speed dyeing and finishing of cottons, rayons and synthetics — where foam interferes. Very low concentrations are recommended. **(No. 1114)**

A versatile new small-scale Dissolver with stainless steel shaft and impeller is especially designed to speed work in labs, pilot plants and small batch production. Gives 2 to 20 times the speed of conventional machines. **(No. 1115)**

A chemically-resistant filter felt made of tightly compacted Dynel fibers bonded with Vinyon has been developed for pressure filters and centrifuges. It is easy to clean, does not shrink. Maximum temperature is 170°F. **(No. 1116)**

A new polyglycol ether removes neoprene protective coatings from aircraft Radomes in less than two hours. Applied as a paste and allowed to stand, the ether reduces to one half a man hour what was once an 8-hour job. **(No. 1117)**

Oxidation of hot solder can now be prevented in continuous operations where the solder is kept molten in the pot. A synthetic wax, put over the top, melts to form a continuous protective coating. The wax also aids fluxing. **(No. 1118)**

A new plastisol gives outstanding adhesion to black iron, steel, galvanized and other metal surfaces, without primers. Used for caulking sewer and drainage pipes, and for drum linings where acid and alkali resistance is essential. **(No. 1119)**

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624 South Michigan Avenue

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IT'S NEW! "316" Stainless Steel Meter with Quantity Control Valve

FOR CORROSIVE LIQUIDS

Controls Cost—Controls Quality

Here's a new money-saving tool for you who blend, batch or otherwise process alcohols, vegetable oils, deionized water and corrosive liquids. It's the popular all-stainless steel Rockwell Rotocycle meter fitted with a predetermining register and an automatic shut-off valve. You just set the quantity you wish the meter to dispense and when this quantity has been measured, the flow is stopped. The stainless steel control valve is of the multi-stage type to avoid hydraulic shock. Use the handy coupon for full details.

ALL TYPES OF INDUSTRIAL METERS Rockwell makes all sizes and types of meters for use by industry. With them you can get positive metered accounting for a multitude of liquids. You can guard the quality of your formulations, keep tab on liquid inventories, have accurate records for cost control and tax analysis purposes. Now is the time to *meter and save.*

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INDUSTRIAL

METERS

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Gentlemen:

I am interested in measuring _____
(Name of Liquid)

Pipe Size _____"

Working Pressure _____psi Temperature _____°F max.

Max. Flow Rate _____gpm Min. Flow Rate _____gpm.

YOUR NAME _____

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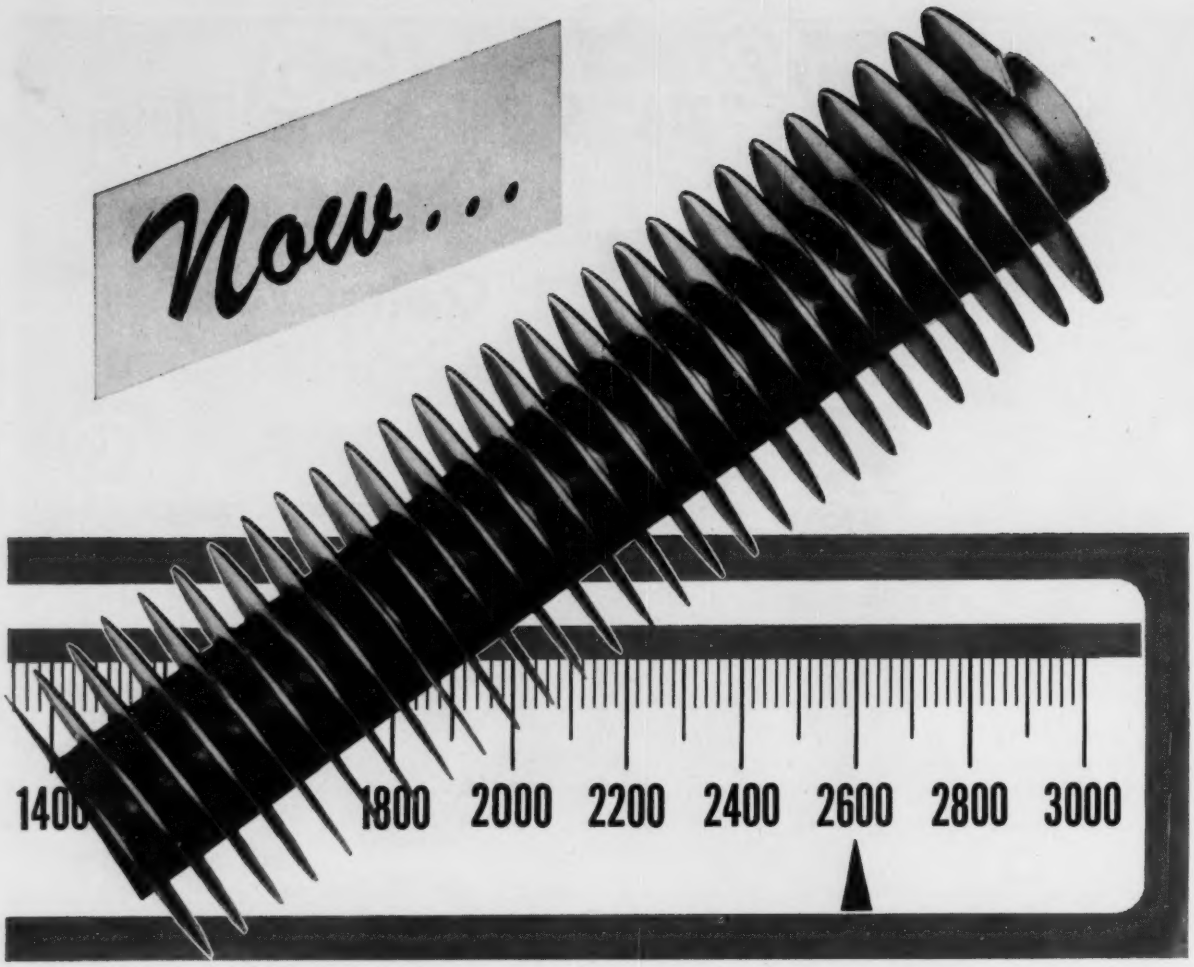
CITY _____ ZONE ____ STATE _____



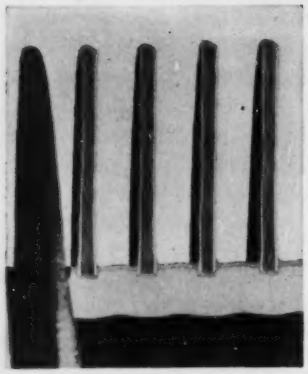


Photo-macrograph of the G-R High-Temperature K-Fin, showing the dual-metal helical fin sealed to the tube by a special brazing alloy. The construction is fully explained in bulletin which will be sent on request.

You can recover heat from gases at extreme temperatures

The G-R High-Temperature K-Fin Heat Transfer Surface now enables you to put to useful work the extremely hot waste gases produced by combustion, by catalytic reactions, or by regeneration of catalysts.

This special G-R finned tube construction can be applied to furnaces or convection heaters with inlet gas temperatures as high as 2600 F, heating fluids such as molten metals to temperatures up to 1500 F.

Write for full information on design and applications. OR 350

THE GRISCOM-RUSSELL CO.
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A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

G-R
HEAT TRANSFER APPARATUS

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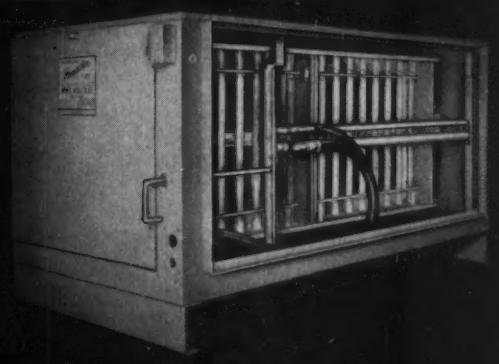
Fact:

Westinghouse Air Handling Provides Effective Control of Airborne Hazards

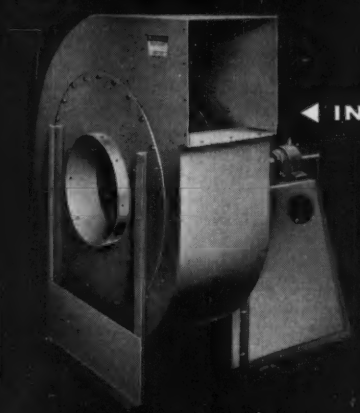
PC PRECIPITRON® ▶

Cabinet-type electronic air cleaner—only 38" in direction of air flow—removes 90% of all dirt, dust, smoke, oil coolant mist—even germs—from atmospheric air.



▲ VENTILATING SETS

Compact, direct-connected, or belt driven for indoor or outdoor installation . . . for fume exhaust, ventilating toilets, stockrooms, locker rooms, and cafeteria kitchens. Readily available!



◀ INDUSTRIAL FANS

Rugged, efficient fans available on short delivery. Exhaust foul air, smoke, gases, fumes, metal dust, chips, shavings—even long, stringy materials. Three types of wheels.

Where health, safety and comfort require putting air to work properly, Westinghouse offers you a complete line of air moving and air cleaning equipment.

Compact and efficient, all Westinghouse units are designed to give long, trouble-free service. And you have the assurance that all parts are made by one manufacturer—one warranty—an exclusive Westinghouse-Sturtevant feature.

MORE FACTS . . . ? Call your nearest Westinghouse-Sturtevant Sales Engineer, he's the "Man with the Facts". . . or fill in the handy coupon below.

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YOU CAN BE SURE...IF IT'S Westinghouse

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Westinghouse Electric Corporation
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Hyde Park, Boston 36, Mass.
Please send more facts on Westinghouse Air Handling Equipment.

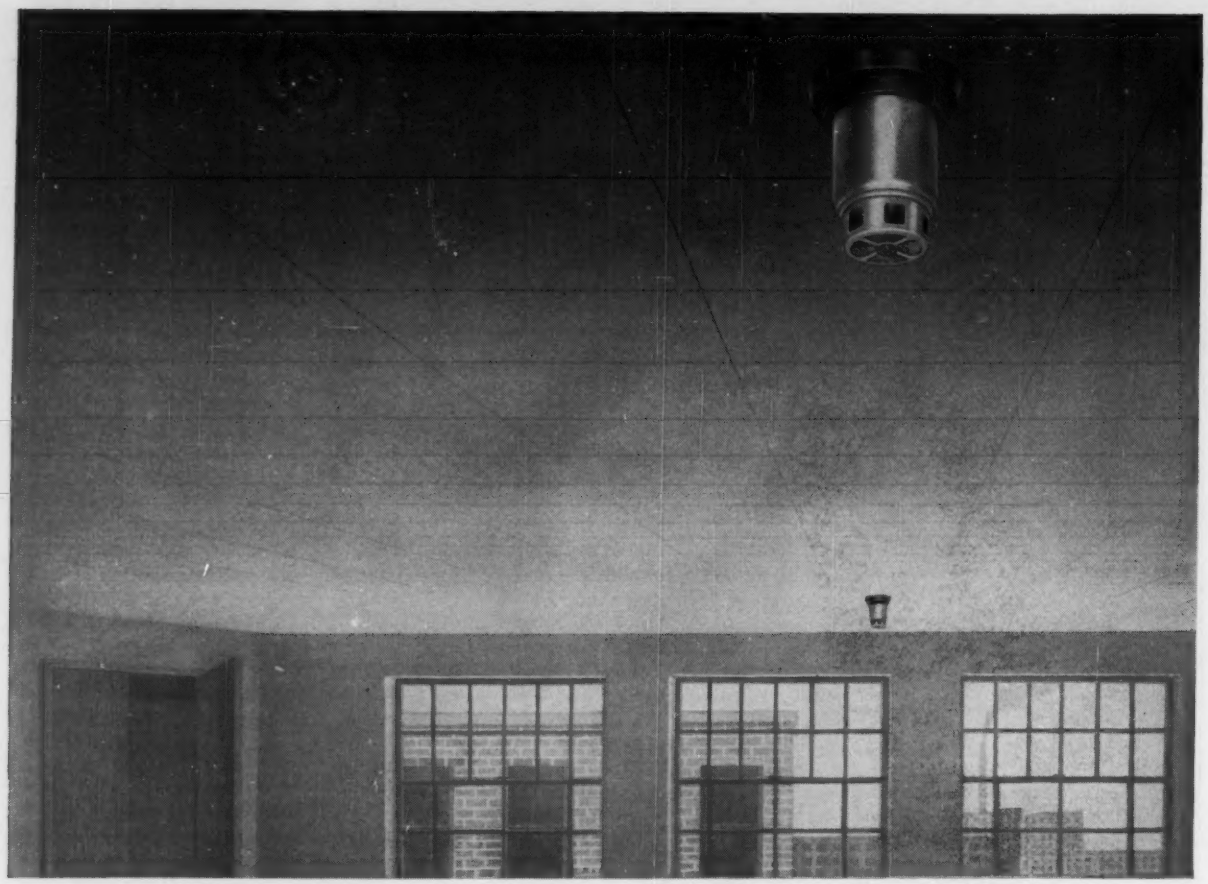
NAME AND TITLE .....

COMPANY .....

CITY .....STATE .....

New, radio-active, automatic fire guard!

C-O-TWO PRE-DETECTOR SYSTEM



Each pre-detector head protects up to 3,600 square feet of area ... harmless radio-active element utilizing ionization chamber principle quickly detects all forms of fire ... requires only simple two-wire circuit and insignificant wall space for controls.

This completely new and positive means of spotting fire is just what you've always needed and wanted ... detects in the earliest stage, invisible combustion gases, visible smoke, slow smoldering, as well as open flame. The C-O-TWO Pre-Detector System is simple to install, extremely economical to maintain and doesn't depend on thick smoke or heat for actuation.

As many pre-detector heads as necessary can be connected together in a single circuit and up to 16 separate circuits or spaces handled by one system. With a single circuit the pre-detector heads are connected directly to the fire indicating cabinet, while with multiple circuits the pre-detector heads are first connected to one or more space indicating cabinets capable of visually showing by number the exact location of the fire. Relays perform such functions as sounding alarms, closing fire doors, shutting down ventilation and releasing fire extinguishing systems.

The C-O-TWO Pre-Detector System has been subjected to extensive testing and carries Underwriters' Laboratories, Inc. listing, as well as Factory Mutual Laboratories approval. Proven pilot installations have been made in such diversified properties as a television station, an electric power company network analyzer room, a railroad signal tower, an airline flight training equipment room and the offices of an insurance company.

Don't take unnecessary chances any longer ... the extensive fire protection experience of PYRENE—C-O-TWO over the years is at your disposal without obligation. Get complete facts about this new C-O-TWO Pre-Detector System today!

Pyrene

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COMPLETE FIRE PROTECTION

portable fire extinguishers ... built-in fire detecting and fire extinguishing systems

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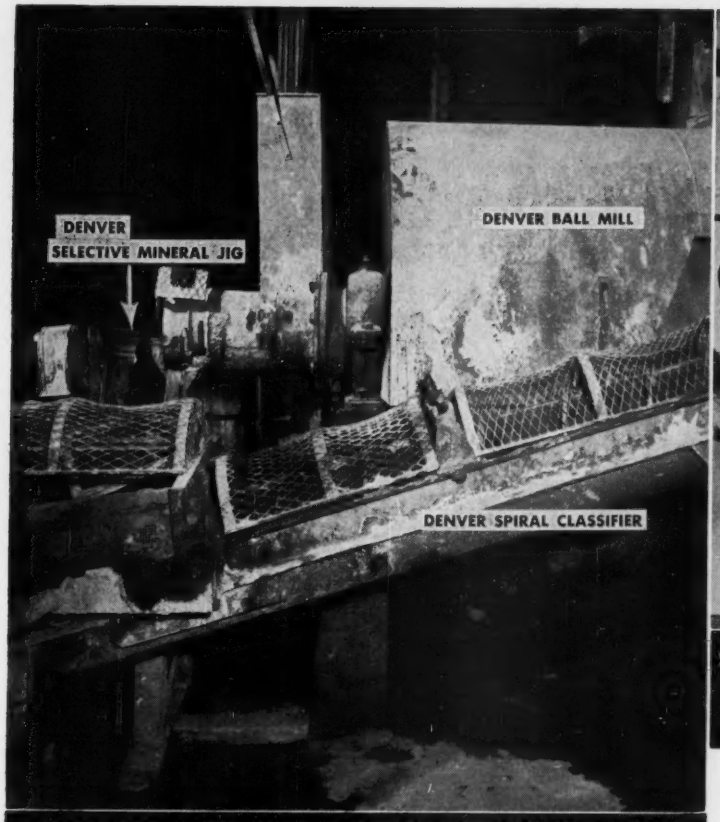
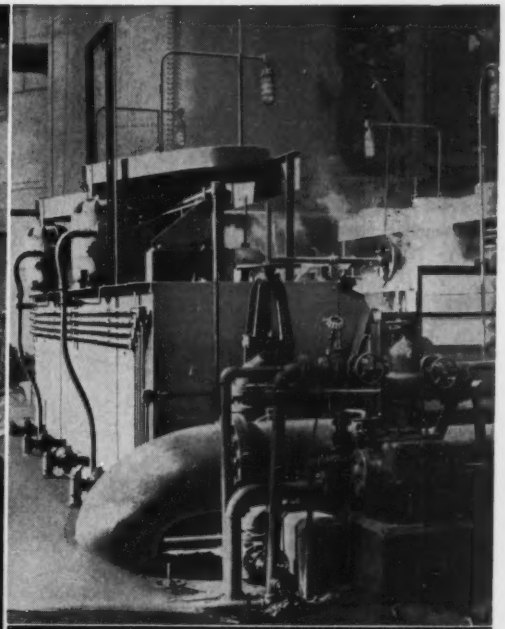
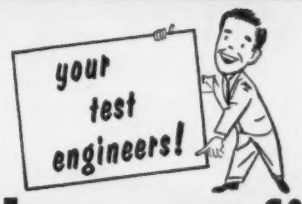


$3,000,000 Recovered Annually A Denver Reclamation System helps recover $3,000,000 in silver from waste photographic film and paper in the world's largest photo chemical plant. Similar Denver Reclamation Systems in other industries recover platinum from refractory slag, aluminum, magnesium, zinc and manganese from slag, low ash coal from stream bottoms, and de-ink waste paper for re-use.



$64,000 Net Profit in 4 Months A large steel corporation recovers naphthalene from the cooling water in their coke plant with a Denver Reclamation System. Recovery of the by-product naphthalene is 100%. Sale of the by-product naphthalene produced a net profit of $64,000 in the first four months' operation.



DECO testing lab shows how profits can be recovered from industrial waste

If you have a valuable product in your industrial waste, find out how Deco can help you recover it at a profit. These case histories are a few examples of how company engineers have worked with the Denver Equipment Company to perfect reclamation systems. These systems have made profits for their owners.

Your engineers are welcomed in our laboratories. We have complete batch test and pilot plant facilities.

There is no obligation to you for a preliminary analysis and recommendation. Write today for details on how to send your samples.

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$43,000 Saved Each Year A Denver Reclamation System is reclaiming formerly discarded molding sand, and saving a large foundry this amount each year. Deco test investigations often can take an operator's or plant engineer's idea and develop a system producing a new profit — giving his plant a new competitive advantage in a profit-tight industry.

We are interested in tests on:

- ☐ Crushing
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- ☐ Anti-Pollution Investigations

☐ Please send me Deco Bulletin "Industrial Application of Denver Equipment."

☐ Please send me complete information and bulletins on making Deco Laboratory Tests.

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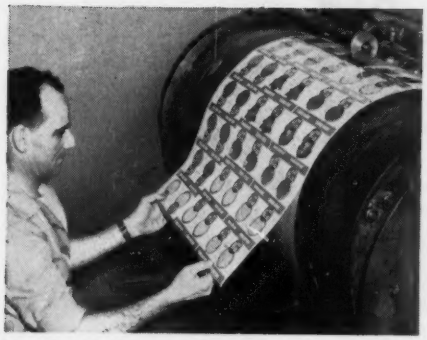
INTRODUCING... Versamid

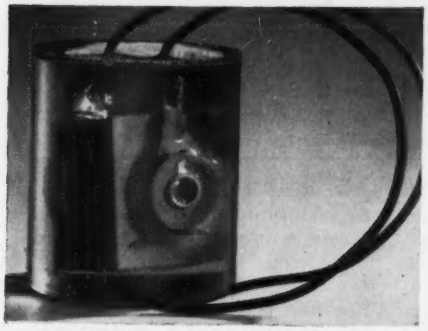
GENERAL MILLS TRADE NAME FOR VERSATILE POLYAMIDE RESIN

General Mills polyamide resins have become so popular in industrial uses, they need and deserve a name of their own. So, General Mills has adopted the trade name "Versamid" for its polyamide resin. The extreme versatility of these resins amazes nearly everyone. You'll appreciate why when you try them yourself. On the next page, you will find brief descriptions and some of the uses for General Mills line of Versamids. For more information, use the coupon lower right.

HOW TO USE *Versamids* FOR PROFITABLE PRODUCTION



Coating paper posters or labels with Versamid, as above, results in a non-blocking film that proves a strong barrier against moisture-vapor penetration.



Tough, bubble-free Versamid-epoxy blends work wonders for electrical embedments, above. They have negligible shrinkage and high dielectric strength. Other special features are low exotherm, long pot life, excellent thermal shock resistance.

Only a few years new, Versamids already have won a big place for themselves in industry. For here are safe, easy-to-use resins that appeal to everyone in the plant—from workmen to formulators. Ask yourself if you can't use these outstanding features:

Versamids require no toxic, volatile or explosive curing agents, even when blended with epoxy resins for special properties. Nor are any volatile reaction products produced during curing. Also, we know of no cases of toxicity or dermatitis caused by Versamids.

They're compatible, too—with each other and with a large number of modifying agents. This allows them to fit your needs exactly. You can blend Versamids to control resin hardness, flexibility, gloss, melting point, heat-sealing temperatures and range, tackiness, and other properties. To extend their versatility further, you can get some Versamids uncompounded (to add plasticizers, waxes, modifying resins) or compounded (for other special properties).

Versamids have sharp melting points. Thus, they heat seal easily, set up quickly without blocking. They resist grease and oil, moisture, wax emulsions, anti-freeze, detergents, alkalis, mild acids, and many solvents and common corrosive chemicals. They may be held at high temperatures for long periods without harm, and are stable for long-term storage.

THERMOPLASTIC USES—Versamids are popular because they meet the needs of a remarkable range of uses. In thermoplastic form, they prove ideal for inks, packaging, overprint varnishes, paints . . . plus flexible adhesives or coatings for paper labels, metal foil, plastic bottles, leather goods, publication covers, and many more—often replacing expensive laminations.

THERMOSETTING USES—When blended with epoxy resin, the Versamid blends are thermosetting and exhibit a whole new range of valuable properties. They're tough and economical, have great adhesion, and resist many corrosive chemicals. They offer low exotherm, high dielectric strength, good heat and color stability, and show a longer pot life than an equivalent mass of monomeric amine-cured resins. As Versamid blends cure quickly, amber clear and relatively bubble free, they improve performance characteristics of glass laminates, pottings and castings, plastic tools and dies, to name but a few.

JUST OFF THE PRESS! New booklet describes each Versamid in detail. Tells where to use them and why. For your free copy write to General Mills or mail the coupon below.

We also manufacture Fatty Nitrogen Compounds and Fatty Acids.

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PROGRESS THRU RESEARCH

General Mills, CHEMICAL DIVISION, KANKAKEE, ILLINOIS

I am interested in investigating the use of Versamids for_____

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Please send me a free copy of your polyamide resin booklet, "Versamids . . . a Demonstration in Resin Versatility."

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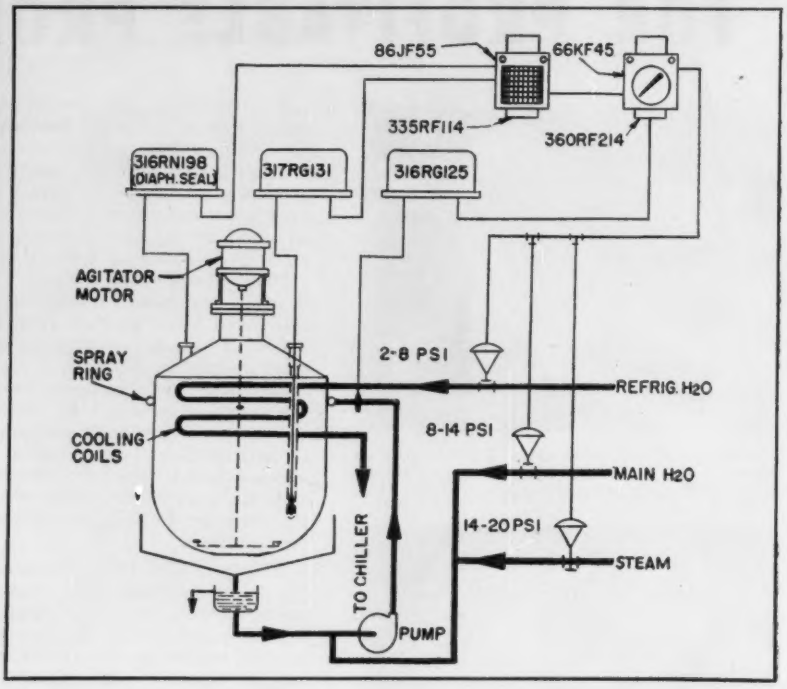
4064-55

REACTOR CONTROL

One of a series of basic instrumentation recommendations for the unit operations

GEORGE E. HOWARD, Manager
Application Engineering Dept.

"Taylor pioneered in the development of control systems for chemical reactors. This recommendation is the result of many years of experience of our application engineers in handling problems inherent in this type of reactor. Data sheets on this and other reactor problems are available on request."



PROBLEM

To achieve maximum yield of specification product in the shortest possible time, with minimum cost. Optimum reaction rate is dependent on precise temperature control. This is difficult because of the lags inherent in the equipment. The principal lags are: the poor transfer of heat from product to the measuring element through a heavy protective well; and slow heat transfer into or out of the product through the vessel wall.

SOLUTION

The first lag problem is compensated for by the use of SPEED-ACT* (derivative) response in the measuring system of the TRANSAIRE* Temperature Transmitter. This permits rapid and accurate sensing of any temperature changes as the reaction proceeds.

Capitalizing on the dynamic accuracy of the TRANSAIRE Transmitter, the TRI-ACT* Controller, with its unique circuit arrangement, makes possible fast "come-up" without overshoot. Yet, it maintains the control point within extremely narrow limits regardless of process upsets. A vital contribution to this precision control is the cascade system which keeps spray-ring water temperature at the value required to accurately maintain product temperature, thus taking care of lag through the vessel wall.

The TRANSET* miniature receiver permits a continuous record of product temperature with the added convenience of auto-manual switching and remote set point change.

BENEFITS

1. Faster, safer "come-up" time.
2. Danger of wild reaction eliminated.
3. Maximum yield of specification product in shortest possible time.
4. Duplication of quality, batch after batch.
5. No loss of raw material due to over or under reaction.
6. Economical production through conservation of heating and cooling media.

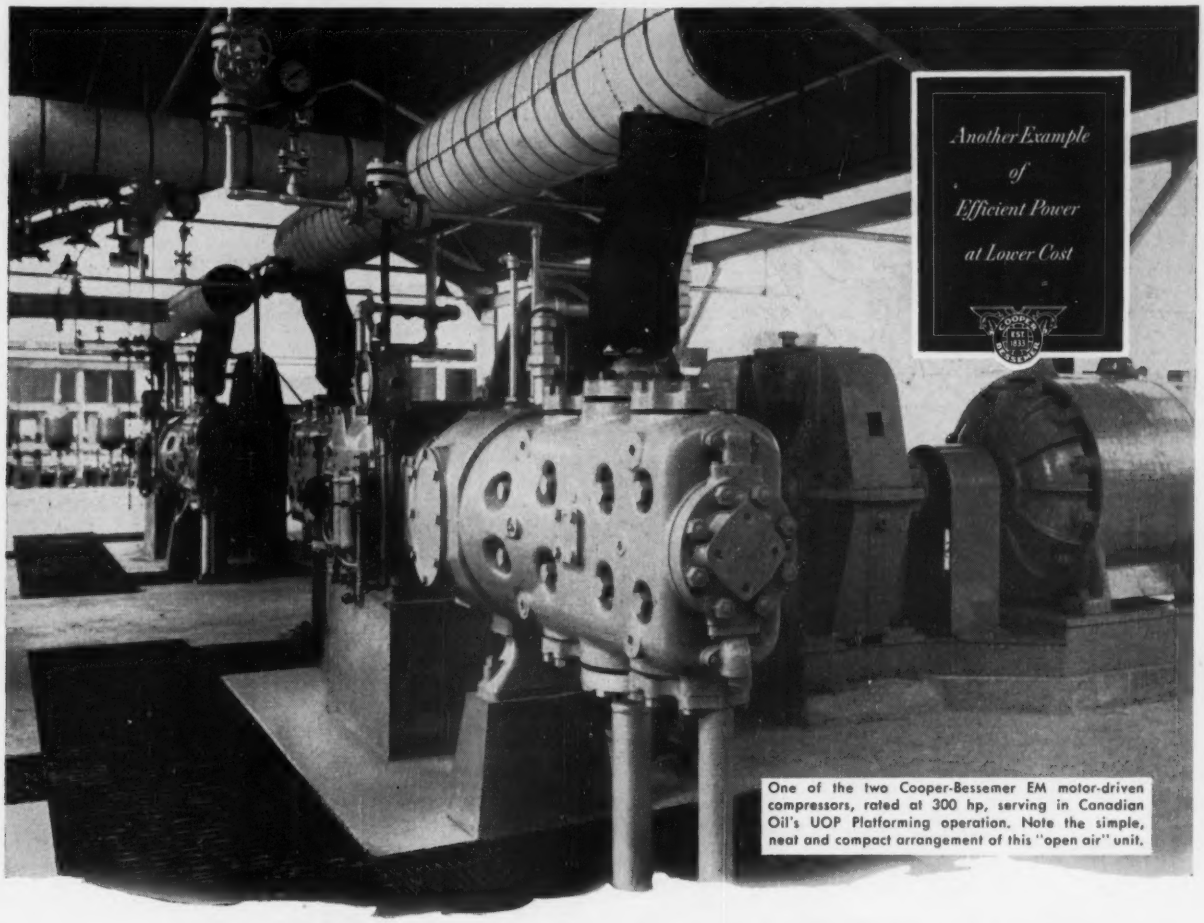
* * *

Reaction problems that might well benefit from such a control system include those involved in the production of Polystyrene, Plastics, Synthetic Rubbers, Synthetic Resins, Antibiotics, Intermediates.

Send for Data Sheet No. 9 covering in greater detail the recommended instrumentation for this and other types of reactors. Watch this magazine for future Taylor advertisements dealing in a similar manner with other unit processes. In the meantime, don't forget that Taylor Field Engineers have had intensive training and many years of experience in solving all kinds of instrumentation problems. They are ready, willing and able to serve you. Taylor Instrument Companies, Rochester, N.Y.; Toronto, Canada.

*Trade Mark

Taylor Instruments MEAN ACCURACY FIRST



One of the two Cooper-Bessemer EM motor-driven compressors, rated at 300 hp, serving in Canadian Oil's UOP Platforming operation. Note the simple, neat and compact arrangement of this "open air" unit.

With CANADIAN OIL'S PLATFORMING UNIT... *a new high in compressor efficiency for high octane gasoline*

COOPER-BESSEMER 2-cylinder motor-driven M-Line compressors efficiently recycle hydrogen for the UOP Platforming unit in the Sarnia, Ontario, refinery of Canadian Oil Refineries, Ltd.

Cooper-Bessemer developed compressors with non-lubricated cylinders have permitted Canadian Oil Refineries to run its Platforming unit thousands of hours without any possibility of contaminating the recycle gas with lubricating oil.

Canadian Oil's Platformer is charging nearly 3800 barrels per stream day, and producing high yields of gasoline with an octane number reaching well into the 90's. In this process, Cooper-Bessemer EM's continue to play a vital and dependable role in the production of high octane gasoline.

If you are considering UOP Platforming, or compressor additions of virtually any type, Cooper-Bessemer offers more than a century of reliable compressor building experience. Contact our nearest office for detailed information.

MOUNT VERNON, OHIO

COOPER-BESSEMER

GROVE CITY, PENNA.

New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS

announcing a new line of **small-size easy-to-read** gauges and receivers

NEW **REPUBLIC 5 GAUGES**

Individual, Independent Measuring Units for
DRAFT • PRESSURE AND VACUUM • DIFFERENTIAL PRESSURE • TEMPERATURE
High Accuracy Receivers for Pnuematic Transmitters and Electric Meters Measuring
FLOW • PRESSURE • CO_2 • DENSITY • LIQUID LEVEL • OTHER PROCESS VARIABLES

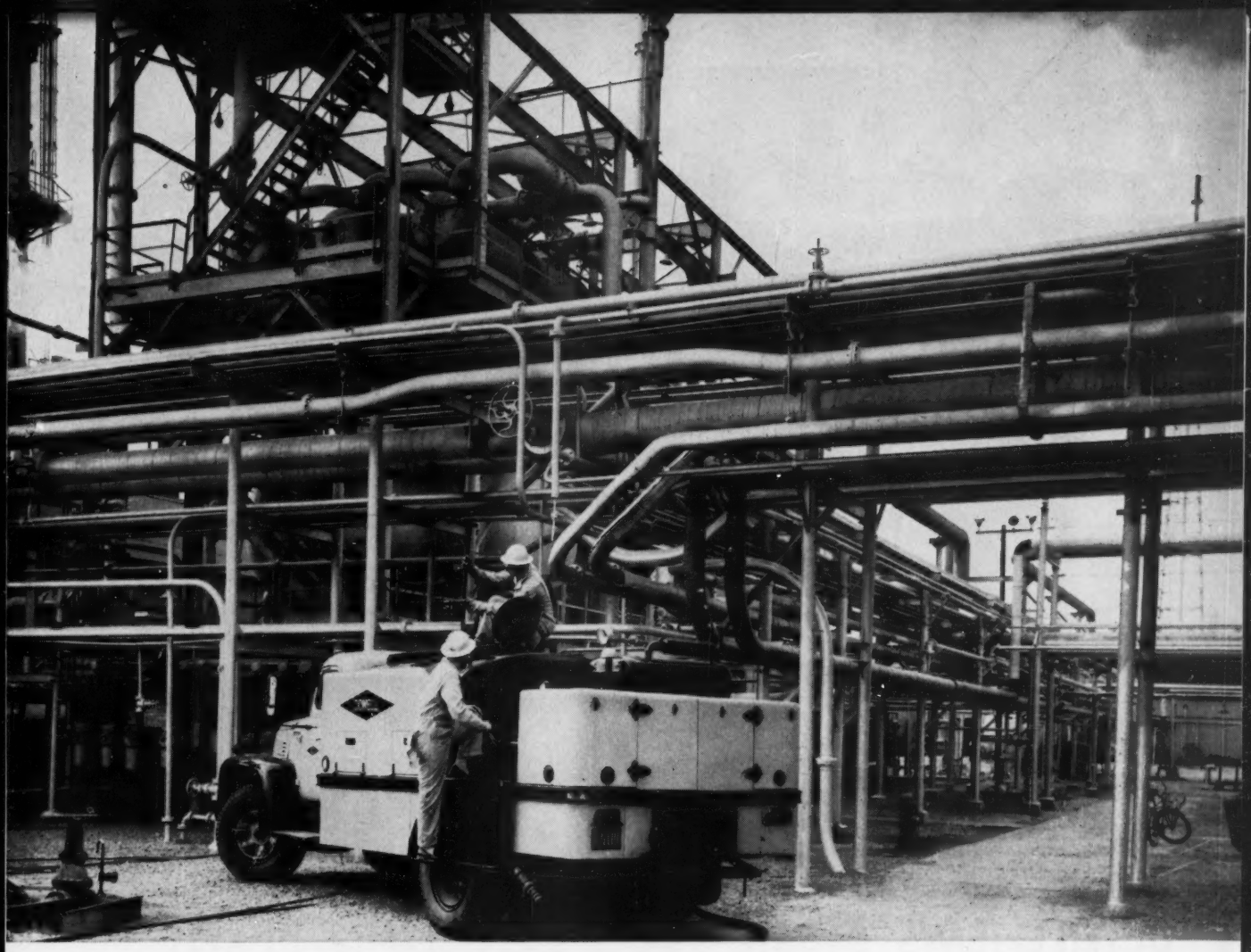
Important Features

- FIVE INCH ILLUMINATED SCALES
- INDEPENDENT, INTERCHANGEABLE UNITS
- MULTIPLE OR INDIVIDUAL MOUNTING — from one to eight units to a single case
- EASILY MOUNTED—no panel drilling necessary in most cases
- SCALES EASILY CHANGED OR COLOR-CODED
- POINTER MOTION REVERSIBLE
- SIMPLIFIED CONNECTIONS AT BACK OF CASE
- REMOVAL FROM FRONT OR BACK

Now you don't have to sacrifice instrument performance and readability to size considerations. With Republic's new line of small-size V5 Gauges, you can save panel space, make more compact instrument groupings and *still* get the accuracy, sensitivity and readability you would expect from conventional sized instruments. Full sized diaphragms, bellows and helix units in V5 Gauges assure "big" gauge performance in an instrument that requires only one-fourth the panel space of conventional gauges. Five inch scales are almost flat and are indirectly illuminated as a standard feature for easy reading — even from a distance.

• ***Write for New V5 Bulletin*** ▶

REPUBLIC FLOW METERS CO.
2240 Diversey Pkwy., Chicago 47, Illinois



SAVED FROM CORROSION DEATH

DOWELL chemical cleaning avoided process line replacement

Replace a 7,000 foot system of 4 and 6 inch process lines, or remove highly corrosive deposits . . . this was the choice that faced the operator in this chemical plant.

His problem: The system carried ethylene glycol. Copper from heat exchangers and expansion joints, plus iron oxides and organic matter, had deposited in the system. They were causing serious corrosion which would eventually require line replacement.

His solution: He consulted Dowell. Dowell engineers tailored a three stage cleaning. With three specially designed solvents, they removed in turn the organic deposits, the iron oxide and associated deposits, and the copper. Lines were flushed with water and blown out with air after each stage.

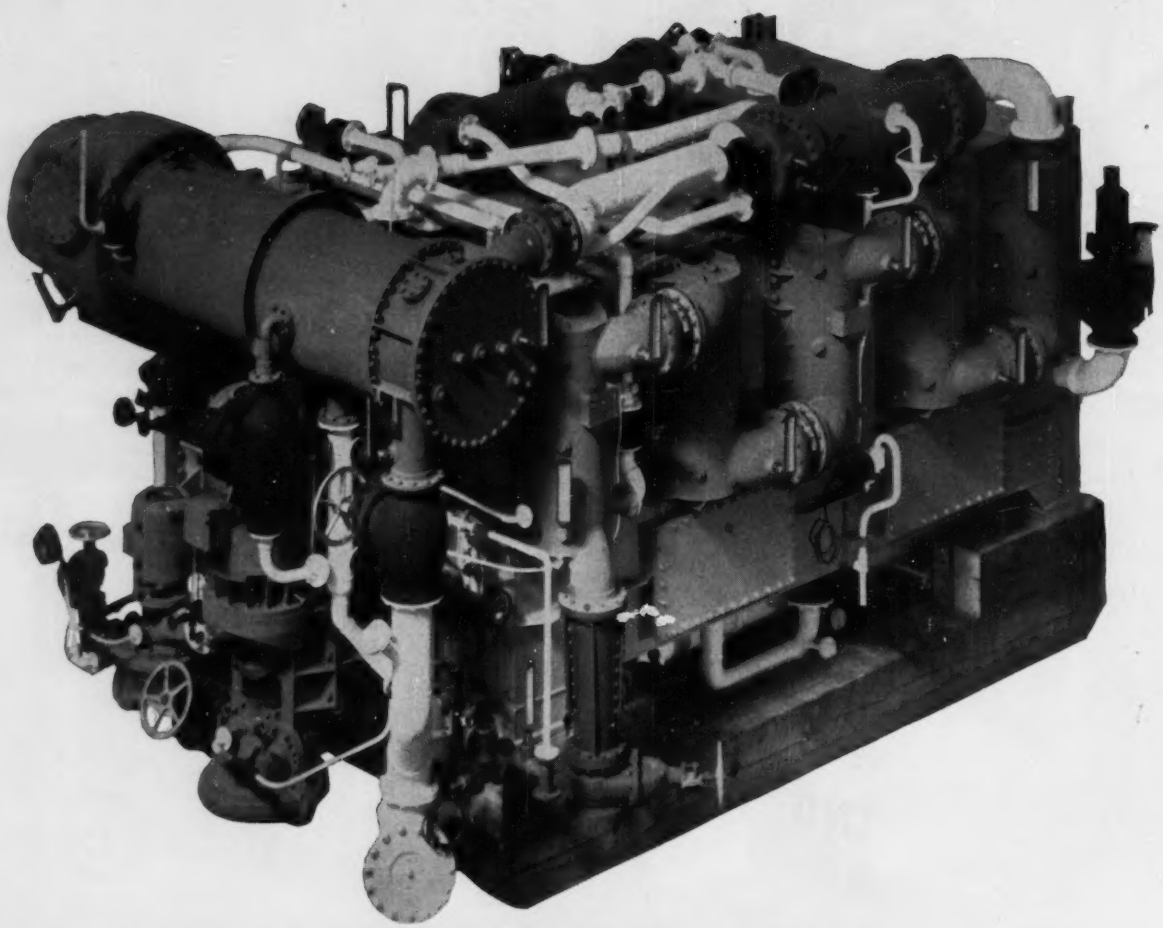
His results: After chemical cleaning by Dowell, the operator inspected the lines. They were virtually 100 per cent clean with no trace of copper remaining. Because clean lines are less vulnerable to corrosion, he was saved additional capital investment.

Dowell engineers use solvents, pumps, sprays, jets, pigs and moles to clean all types of industrial equipment. Call Dowell for fast service. Offices and stations are located in major industrial areas. Or for more information, write Dowell Incorporated, Tulsa 1, Oklahoma, Department J-33.

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY



BETHLEHEM'S **Flash-Type** DISTILLING PLANT FOR LAND OR SEA OPERATION

Converts Sea Water into High-Purity Fresh Water in the Most Economical, Efficient and Dependable Manner Yet Developed

★ Low-pressure, vacuum flash-method holds top temperature to 170° F; virtually eliminates scale problem.

★ Single or Multistage, in capacities from 5,000 to more than 1,000,000 gallons daily; 12-stage uses 33½ pc less steam.

★ Simple two valve control; no skilled operator required; once started operates unattended; thoroughly dependable.

★ More compact; weighs less; small size of shells facilitates use of materials (90-10 CuNi) best for sea water service.

★ Larger units easily disassembled for rail, truck or ocean shipment; simple reassembly; teams up with existing power installations.

★ Promises substantial money savings over present methods; *Pays for Itself* ASHORE OR AFLOAT.

Your inquiries will receive prompt attention.

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Geared Turbine Propelling Machinery
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Fabricated Steel and Weldments for Floating Equipment, Machine Work

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This 24-page booklet alphabetically lists the many chemicals available from Harshaw. Read the story about Harshaw's growth since its beginning in 1897. Pictures of plants, warehouses, research and manufacturing operations are scattered throughout the book. We will gladly send you a copy if you write.

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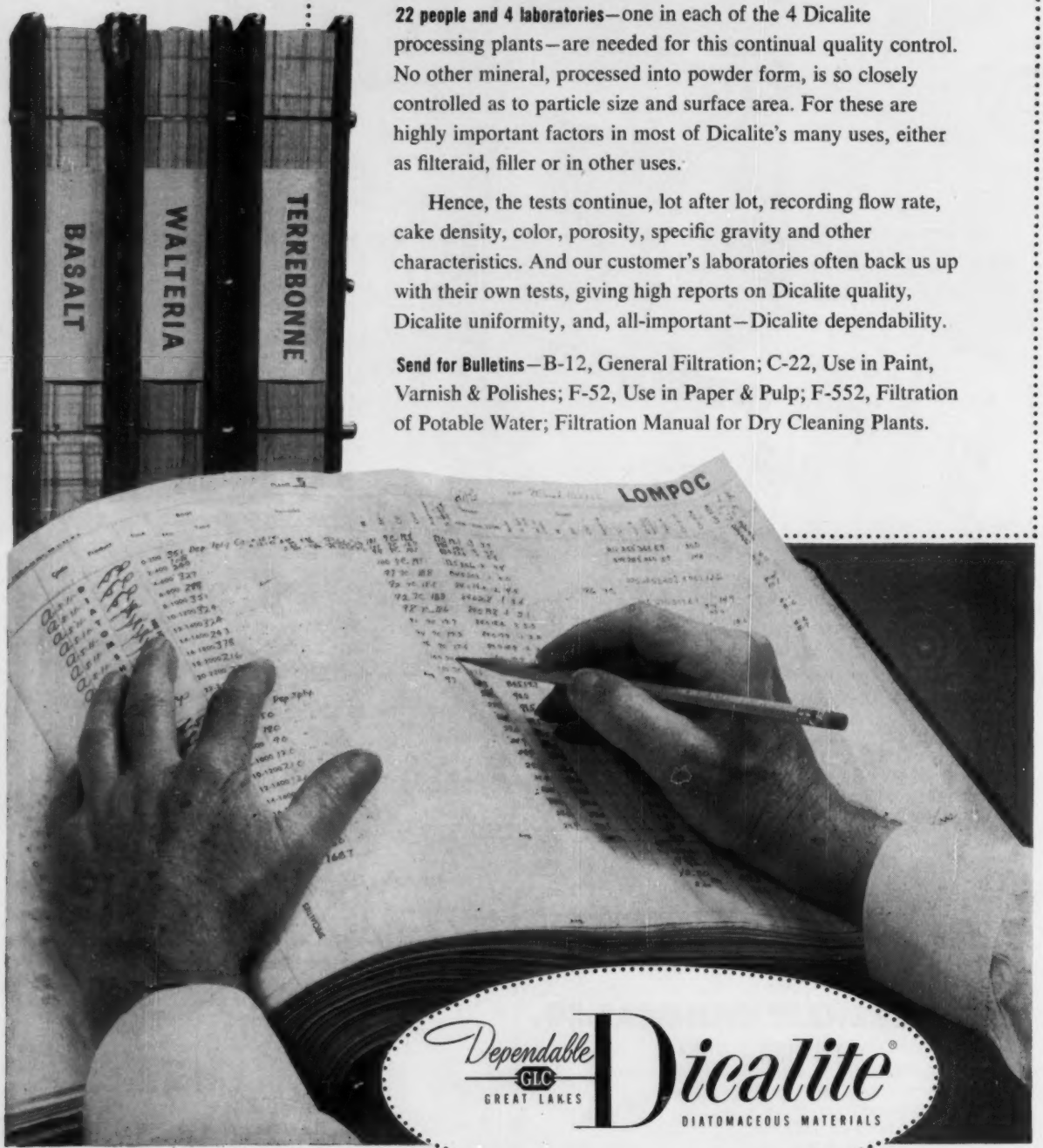
23,896 "Watchdogs" Every Month...

That's the *average* number of laboratory tests we make each month to insure that every run of every Dicalite product will render uniformly high performance. (The actual number varies, and depends on the different Dicalite products run.)

22 people and 4 laboratories—one in each of the 4 Dicalite processing plants—are needed for this continual quality control. No other mineral, processed into powder form, is so closely controlled as to particle size and surface area. For these are highly important factors in most of Dicalite's many uses, either as filteraid, filler or in other uses.

Hence, the tests continue, lot after lot, recording flow rate, cake density, color, porosity, specific gravity and other characteristics. And our customer's laboratories often back us up with their own tests, giving high reports on Dicalite quality, Dicalite uniformity, and, all-important—Dicalite dependability.

Send for Bulletins—B-12, General Filtration; C-22, Use in Paint, Varnish & Polishes; F-52, Use in Paper & Pulp; F-552, Filtration of Potable Water; Filtration Manual for Dry Cleaning Plants.



DICALITE DIVISION • GREAT LAKES CARBON CORP.
612 S. FLOWER ST., LOS ANGELES 17, CALIFORNIA

FIRST in Performance
because it's
FIRST in Design

New Model HA PAYLOADER® Tractor Shovel

with 40 degree bucket tip-back and powerful break-out action

FIRST in Digging Capacity
FIRST in Lifting Capacity
FIRST in Carrying Capacity
FIRST in Maneuverability
FIRST in Safety

The 1955 Model HA "PAYOADER" has gone to work in all kinds of manufacturing and processing plants and has already proven that it is a production champion. It has an 18 cu. ft. bucket — the biggest capacity in its class — and an amazing new bucket action. Long-time "PAYLOADER" users as well as new owners report new highs in production and new lows in bulk-material handling costs with the new HA.

They praise the 40 degree bucket tip-back at ground level that digs heaped bucket loads easily — up to a ton in weight — and carries them close and low for fast, safe transport without spillage. They like the increased power, the ease and speed of operation that comes from torque converter drive, easy steering and powerful hydraulic brakes.

Your PAYLOADER Distributor is ready to show what the new HA can do on *your* bulk-material handling work.

☐ Send data on Model HA (18 cu. ft. bucket capacity)
☐ On larger 2-wheel drive models
☐ On larger 4-wheel drive models
☐ On "PAYLOADER" towing tractors

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Company .....
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City .....
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Co

SAY "HUFF"

PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY INTERNATIONAL HARVESTER COMPANY

PROVEN by 8 years

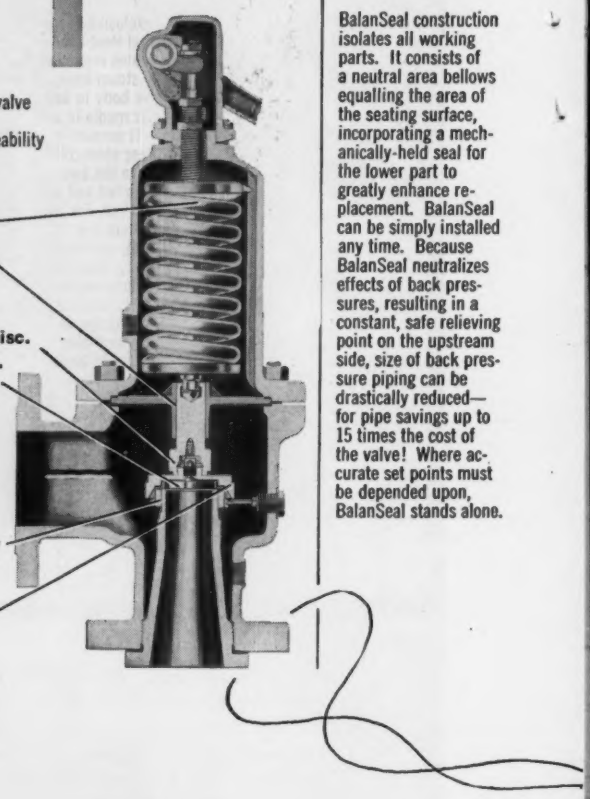
THOUSANDS of Successful Installations of Farris "4 in 1" Safety Relief Valves*

NOTICE: Farris Safety Relief Valves, the Internal Heat Exchanger, and Bellows construction are covered by U.S. Patents and Patents Pending. Copyrights, where applicable, are registered.

1 STANDARD FULL NOZZLE SAFETY RELIEF VALVES

Here is the ultimate in nozzle valve construction with complete standardization and interchangeability in every part:

- Round wire springs calibrated for rating.
- 2½ to 1 guiding ratio, close tolerances.
- Alignment spool for perfect alignment and bearing from stem to disc.
- Self-aligning, optically-flat replaceable disc of forged Stainless Steel.
- All bearings of hardened Stainless Steel.
- Expanded orifices increase capacity.
- Single blowdown ring does not affect capacity —simple adjustment.
- Flared disc-holder for ultimate operating efficiency.



BALANSEAL© SAFETY RELIEF VALVES

BalanSeal construction isolates all working parts. It consists of a neutral area bellows equalling the area of the seating surface, incorporating a mechanically-held seal for the lower part to greatly enhance replacement. BalanSeal can be simply installed any time. Because BalanSeal neutralizes effects of back pressures, resulting in a constant, safe relieving point on the upstream side, size of back pressure piping can be drastically reduced—for pipe savings up to 15 times the cost of the valve! Where accurate set points must be depended upon, BalanSeal stands alone.

For eight years Farris has been setting-the-pace-in-safety with "4-in-1" Safety Relief Valves, the "standard" for long service life, minimum maintenance and positive protection.

Farris' recognition as the pace-setter of the industry is no accident, but the result of many engineering "firsts" in improved valve design—FIRST with balanced bellows construction . . . FIRST to offer multiple nozzle sizes within one valve . . . FIRST with a line of bar stock safety-relief valves for pressures to 10,000 lbs. . . . FIRST to offer internal heat exchangers . . . FIRST to offer realistic pricing, giving the customer the benefit of manufacturing economies . . . and only Farris can point to proved-in-service performance . . . because Farris is the pioneer manufacturer of safety relief valves with bellows.

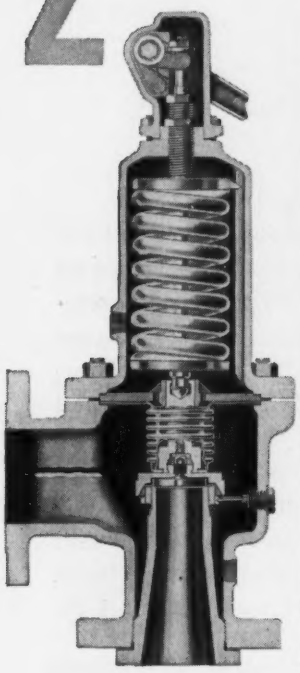
FOR ENGINEERS: Catalog 48Ra on the full line of Farris Safety Relief Valves; and Technical Manual 51B—"Principles of Manifold Discharge Piping". Available on request.

"THE FOX AND THE HARE"

Send for this popular entertaining pamphlet presenting a story about the recognition of BALANSEAL valves. It is humorous and enlightening. Just ask for it by name.

# of ACTUAL SERVICE

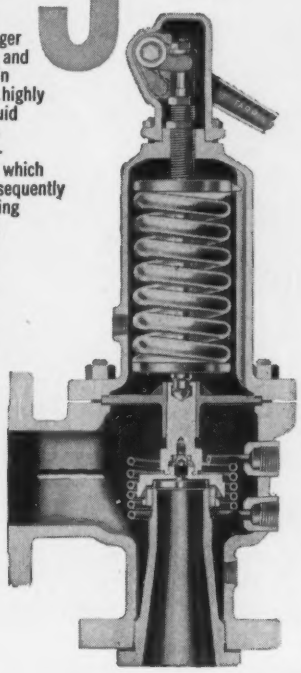
2



INTERNAL HEAT EXCHANGER

The exclusive Farris Internal Heat Exchanger eliminates inefficient and costly steam tracing in a valve body to keep highly viscous media in a fluid state. It consists of a stainless steel coil inserted in the body to which steam is fed and subsequently trapped out. For placing heat where it is most effective, increasing efficiency, lowering steam consumption, the Farris Internal Heat Exchanger is the only available product of its kind.

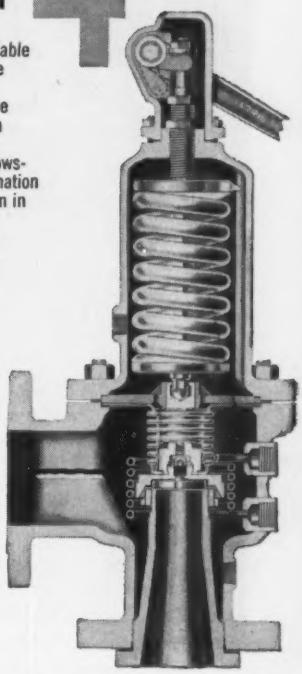
3



BELLOWS—HEAT EXCHANGER COMBINATION

For completely dependable valve operation in spite of sticky fluids (tars, asphalt, etc.) and where complete freedom from contamination is required, select the Bellows-Heat Exchanger combination . . . The ultimate design in safety relief valves for applications where material is highly viscous. All parts are Farris Standard construction.

4



***CERTIFIED AND APPROVED by the National Board of Boiler and Pressure Vessel Inspectors, complying with ASME requirements. Tests made at university laboratories by independent observers. Certification data available on request.**

and Still the Lowest Prices in the industry!

Coming Soon!

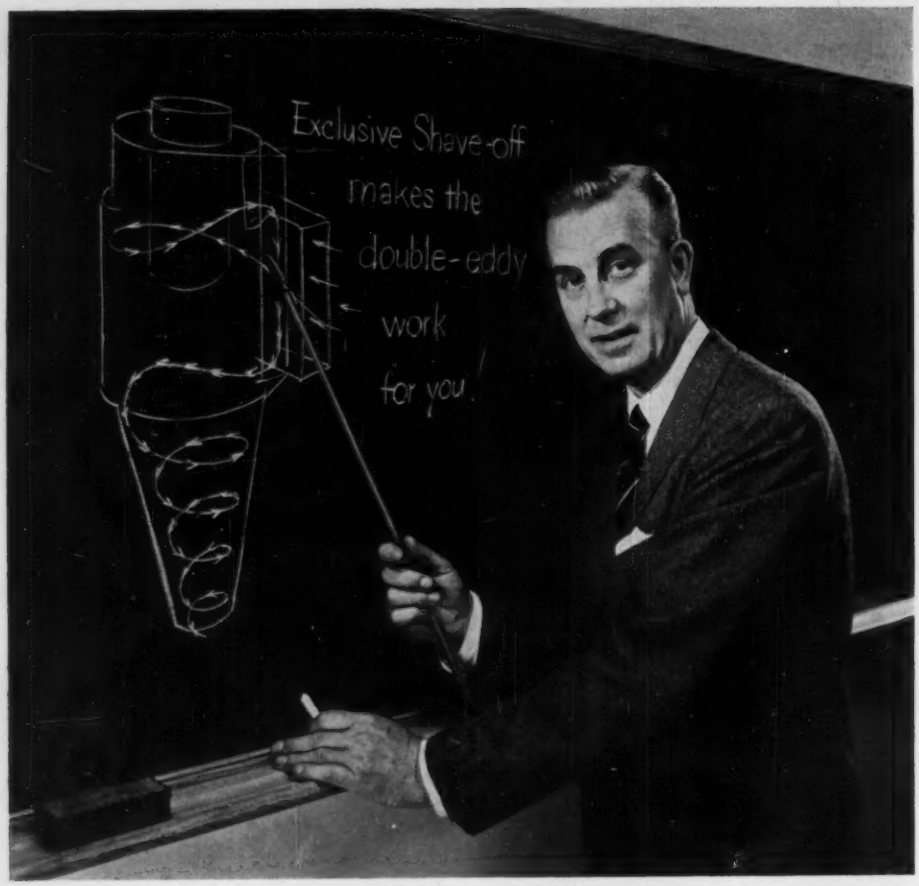
An added line of ultimate capacity nozzle valves

Farris ENGINEERING CORPORATION

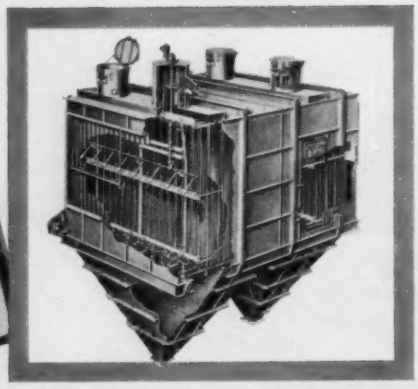
405 COMMERCIAL AVENUE, PALISADES PARK, NEW JERSEY

Affiliates: Farris Flexible Valve Corp. • Farris Stăcon Corp. • Farris HydroTorque Corp. Farris HydroSeal Corp. • Farris Pickering Governor Co.

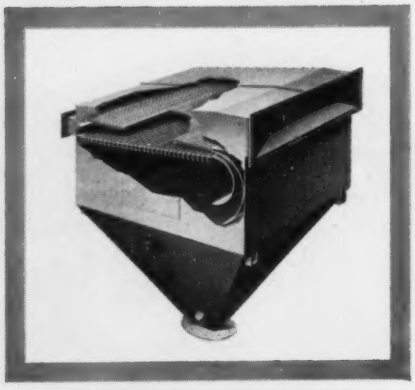
How Buell delivers the EXTRA PERCENT in Dust Collection Efficiency



In any cyclone dust collector there is an upward eddy preventing the separation and dropping-out of a percentage of particles. But in Buell Cyclones, the exclusive Buell shave-off design *harnesses* this up-flow—puts it to work! Result: extra efficiency without extra operating cost!



SF Electric Precipitator, a Buell exclusive, also delivers *extra efficiency* due to unique Spiralectrodes and continuous cycle rapping.



Buell's Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for either natural or forced draft installations.

For the complete story
behind Buell's *extra efficiency*,
write Dept 12-J,
Buell Engineering Company,
70 Pine Street, New York 3, N. Y.

buell®

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in **DUST COLLECTION SYSTEMS**

FP *complete process instrumentation*

F&P's new differential pressure transmitter

Announcing F&P'S New Force-Balance Transmitter

Sealed diaphragm differential pressure transmitter

F&P is proud to announce a brand-new, trouble-free pneumatic oil-sealed flow-transmitter. With the F&P Transmitter, it is now possible to measure differential pressure instantaneously and accurately. No working parts contact the process fluid. The fluid pressures are exerted on the smooth outside surfaces of two diaphragms which transmit pressure differential through a sealed-in oil chamber between them.

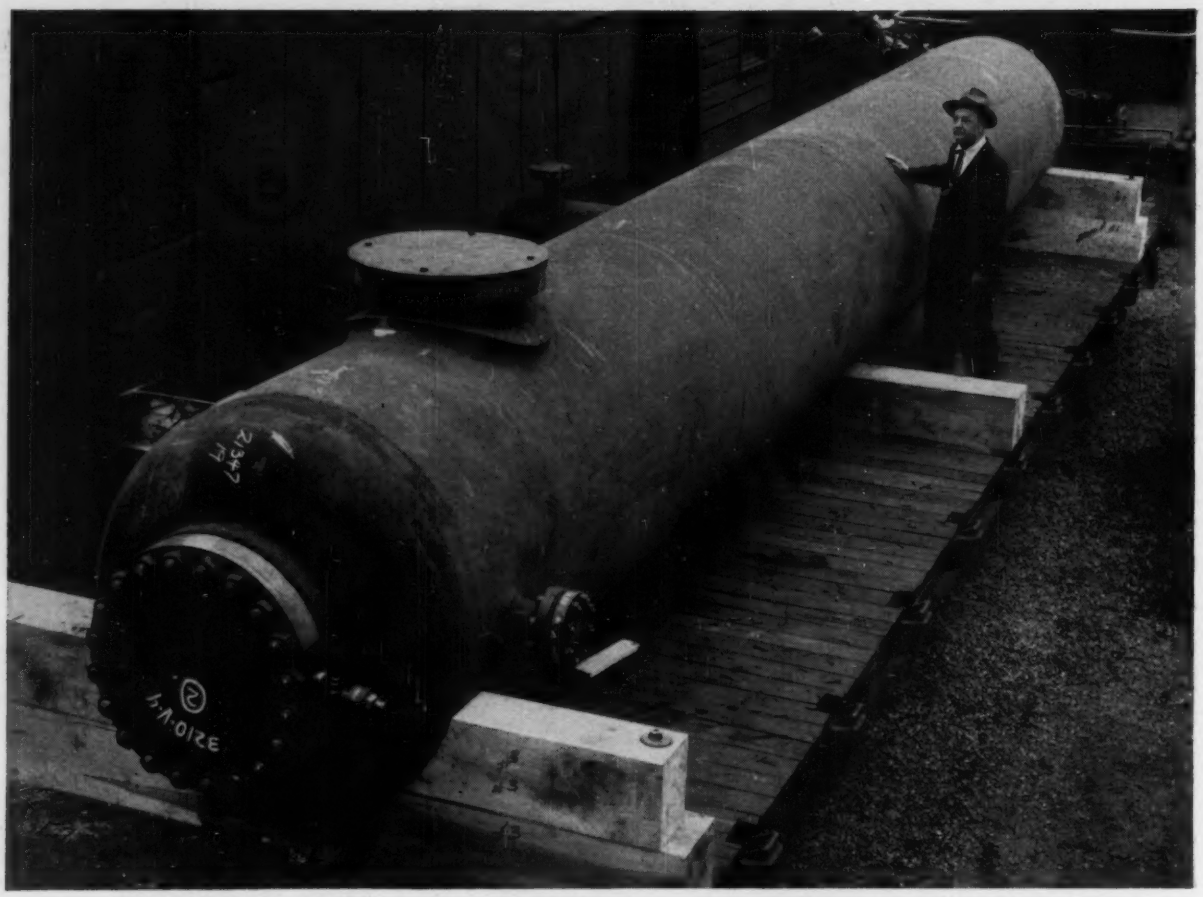
These are its features:

- All working parts sealed from process fluid
- Process fluid enters only two smooth, pocketfree cylindrical chambers
- Meter body and transmitter are separate assemblies for greater accuracy, and for easier adjustment or maintenance
- Adjustable damping built into meter unit to minimize pulsation and vibration effects before they reach the transmitting half of the instrument
- Outstanding stability and rigidity for maximum accuracy, minimum adjustment
- Internal hydraulic temperature compensation

FISCHER & PORTER COMPANY
COUNTY LINE ROAD • HATBORO 6, PA.

Measuring, recording and controlling instruments
Centralized control systems
Data reduction and automation systems
Chlorination equipment
Industrial glass products

Sales offices in 32 American cities and in principal cities abroad



NEWPORT NEWS BUILT two 39'-7" horizontal gas scrubbers, such as this, for J. F. Pritchard & Co. They were made of ASTM-A212 Grade B fire box steel, with structural mesh steel interiors.

Gas scrubber made of 2⅞" steel

Newport News builds almost any type of pressure vessel and other heavy process equipment

Here is one of two horizontal gas scrubbers recently built for an operating pressure of 1800 psi at 300°F.

Newport News made both vessels from fire box steel, 2⅞ inches in thickness. We formed and automatically welded this steel into sections having a diameter of only 4 feet.

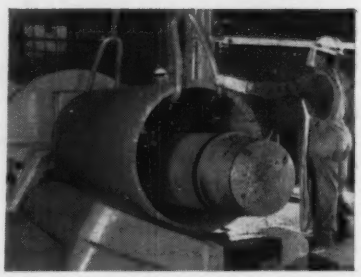
Rolling thick steel to this small diameter...no easy accomplishment, as you probably know . . . demonstrates the sort of jobs Newport News takes in stride.

Almost any type of heavy processing equipment is readily constructed by Newport News in a 225 acre plant comprising huge, fully equipped fabricating and machine shops, foundries, forge and die shops, heat treating and allied equipment as well as complete test facilities.

Newport News shop erection of fabricated units helps to speed assembly at your plant site.

Get a bid from Newport News on your present or future projects. Get the benefit of specialized production techniques. Look over the many ways in which Newport News can help you . . . write for "Facilities and Products", a very interesting booklet. It's yours for the asking.

ENGINEERS Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.



ROLLING 2⅞" STEEL for gas scrubbers. The steel, in a hot condition, was formed on the heavy bending equipment shown here. It will cold roll mild steel up to 3 inches thick, and will hot roll any grade of steel up to a thickness of 5 inches.

Newport News Shipbuilding and Dry Dock Company
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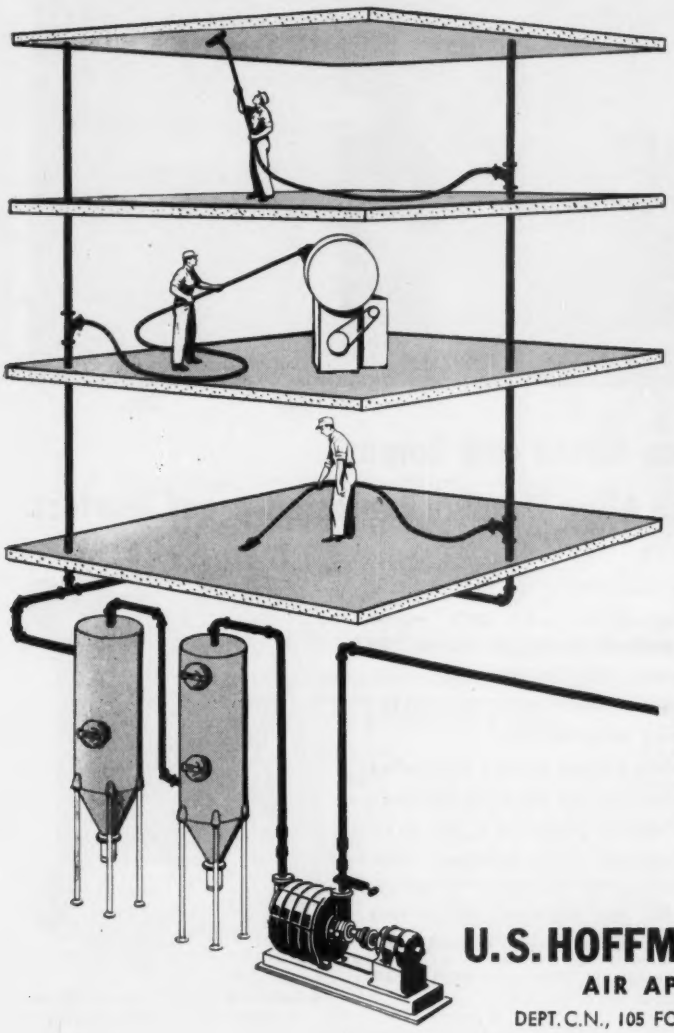
FOR REMOVAL AND RETENTION OF CHEMICAL DUSTS, YOU CAN'T EQUAL A HOFFMAN BUILT-IN VACUUM SYSTEM



Combining the functions of a pneumatic conveyor system which unloads at a central point and a powerful, on-the-spot vacuum cleaner explains why the Hoffman Vacuum Installation is the "perfect performer" for clean-up and removal of dry chemicals and other materials.

Constant suction is piped to convenient outlets throughout the plant, and flexible hoses snap on to these outlets for quick thorough cleaning of walls, ceilings, equipment, and tables—as well as floors. A wide range of nozzle sizes and shapes makes it easy to dry scour any surface. And the powerful suction lifts and takes out just about anything that is dry and not nailed down.

All suction lines discharge into central collectors, where the transported matter is removed from the air stream and held for later salvage, disposal, or other treatment.

Heart of the Hoffman pneumatic systems is the famous, unique Hoffman Multi-Stage Blower and Exhauster—which serves equally well in supplying air pressure up to 9 lbs. psi, or vacuum to 12 inches Hg. These air movers are built to serve non-stop for long periods with minimum noise—no pulsation. They have no valves, vanes, pistons, gears, or other impacting and wearing parts to cause vibration and frequent maintenance.

When any form of pneumatic applications is a need, or problem, in your operation, call in the Hoffman engineers—first thing!

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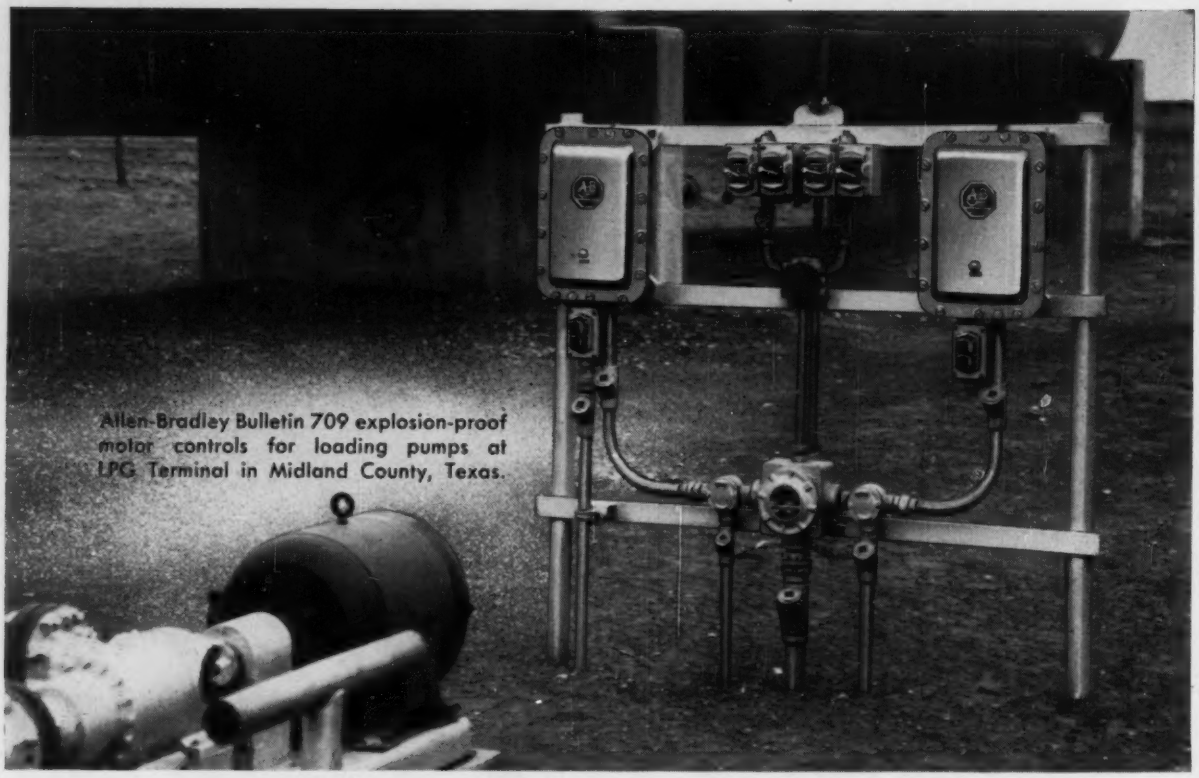


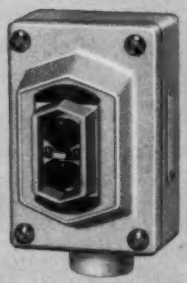
Allen-Bradley Bulletin 709 explosion-proof motor controls for loading pumps at LPG Terminal in Midland County, Texas.

For Hazardous Gases and Fumes, Use Allen-Bradley Explosion-proof Starters

A-B Quality

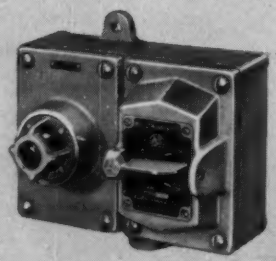
The Sign of QUALITY Motor Control

Bulletin 600 Type 7 Manual Starter for Small Motors.



Bulletin 800 Type 7 Push Button Station.

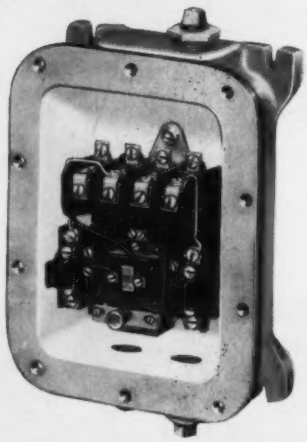
Manual Starter with Pilot Light. The Allen-Bradley Handy Catalog lists explosion - proof, weatherproof, and watertight starters as well as starters in general purpose enclosures.



The explosion-proof starters . . . shown above . . . are "safe" where hazardous gases or fumes are present. The bolted covers with wide machined flanges meet NEMA Type 7 specifications.

Allen-Bradley starters with bolted covers are no servicing problem; silver alloy contacts are used throughout, which need no filing, cleaning, or dressing. Cover removal can therefore be a rare event. You can install Allen-Bradley solenoid starters . . . and forget them.

Send for the A-B Handy Catalog.



Bulletin 709 Size 1 Solenoid Starter in NEMA Type 7 explosion-proof enclosure.

Allen-Bradley Co.
1337 South First Street, Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

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For low-temperature processes

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2. Close temperature approaches—economically maintained—lower operating costs.

For temperatures as low as −300°F. in nitrogen production and hydrogen purification processes, TRANE Brazed Aluminum Heat Exchangers are proving themselves a flexible, economical solution to difficult heat exchange problems. They're cutting costs *two* important ways!

Lower initial costs account for one substantial saving. Efficient, *flexible* TRANE Brazed Aluminum surfaces make it possible to handle multiple streams in a *single unit.*

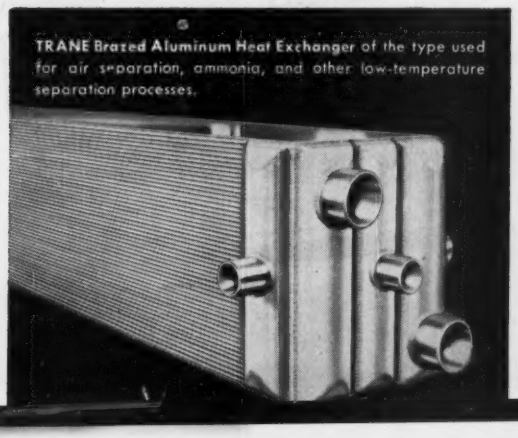
(Even installation costs are lower. These compact, lightweight units pack up to 450 square feet of heat transfer surface into a single cubic foot. They are now available in operating pressures *up to 600 psig!*)

Lower operating costs, plus the ability to perform efficiently and economically at low temperatures represent still another saving. Even when large heat transfer duties are involved, these units can provide temperature approaches of 5°F. or closer—*economically!* Operating costs are lower because it takes less refrigeration to bring a specified liquid or gas to desired temperature.

Little wonder, then, that so many new, modern air separation and ammonia plants rely on efficient TRANE Brazed Aluminum Heat Exchangers.

If you have a heat transfer problem—if it involves *low temperatures, multi-stream exchange* or *close approaches*—it's time to call TRANE.

Our 30 years' experience in all phases of heat transfer is at your disposal. Just contact your nearest TRANE Sales Office. There is one near you in our network of 90 U.S. and 17 Canadian offices. Or write on company letterhead to TRANE, La Crosse, Wis.



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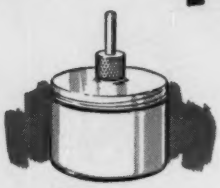
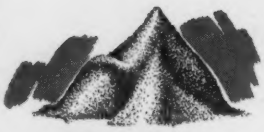


Pastes

Paper coating, starch, seam paste, size, adhesive dope, heavy grease, graphite sludge.



Abrasives

Insulator clay, frit, ground glass and water, porcelain glaze and enamel, cement, plaster.

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Positive displacement—Moynos can deliver up to 250 g.p.m.; pressures to 600 p.s.i.

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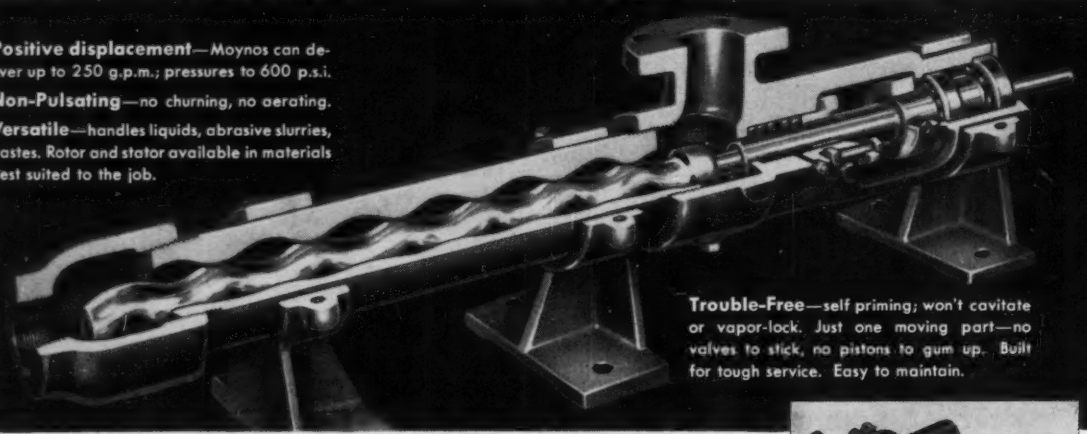

Trouble-Free—self priming; won't cavitate or vapor-lock. Just one moving part—no valves to stick, no pistons to gum up. Built for tough service. Easy to maintain.

R & M Moynos handle almost anything that can pass through a pipe

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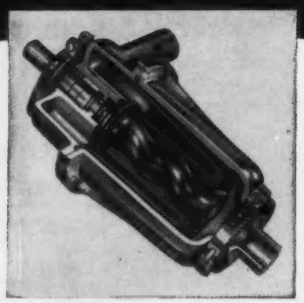
This is how the Moyno works: a screw-like rotor turning within a double-threaded stator creates cavities which *progress* toward the discharge end of the pump, carrying the material being handled. The result is a smooth, steady flow, free from pulsation and turbulence.

The pumping elements of the Moyno are available in a wide range of materials, depending upon the substances to be pumped. From stainless steels and synthetic rubber to tool steels, bronze, plastics—there is a Moyno that will do the job you want, and do it with remarkable efficiency.

Industrial-type Moynos are available with capacities to 250 g.p.m.; pressures to 600 p.s.i. Small Moynos (see inset), used as original equipment, serve on washers, water pumps, sprayers, and many other products.



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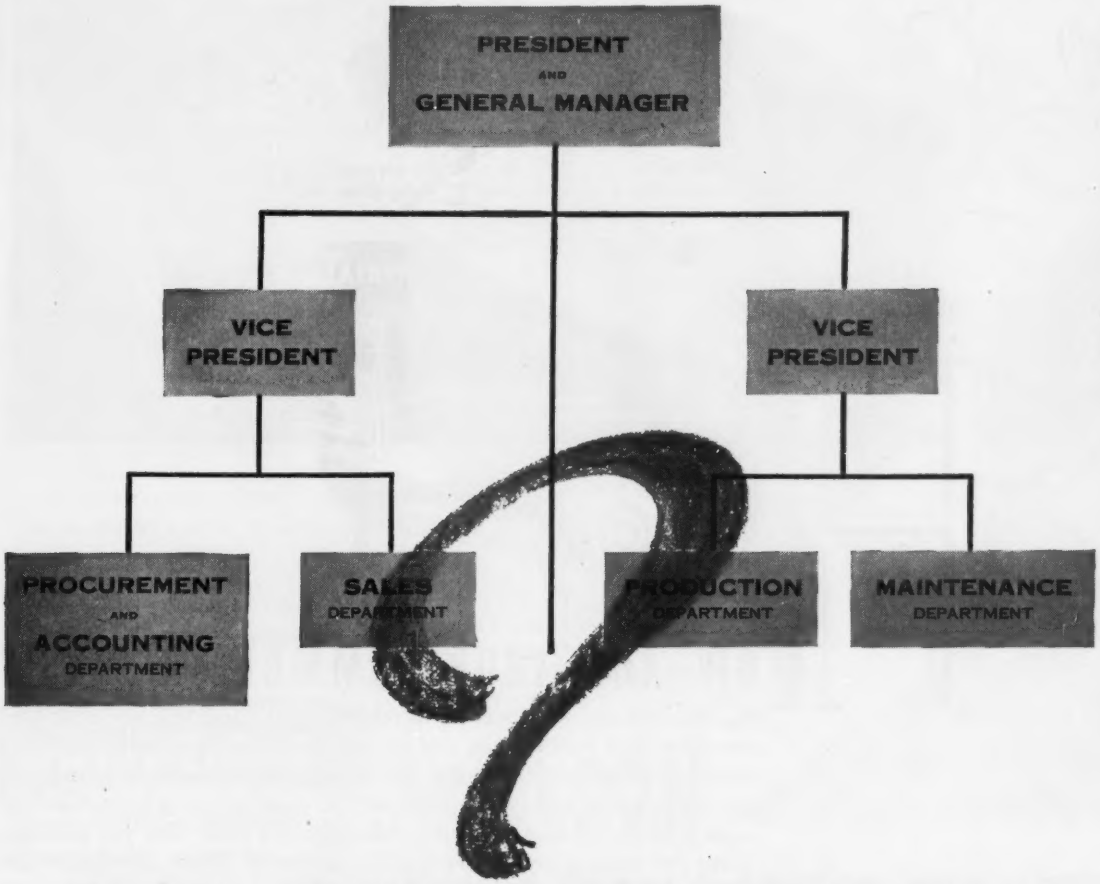

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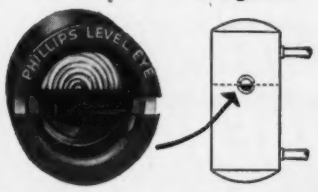

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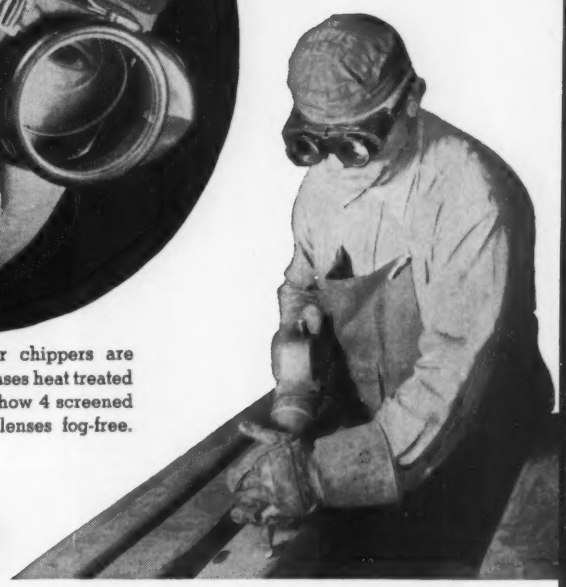

Kover-Mor® Goggles designed for chippers are fitted with Willson *Super-Tough* lenses heat treated for greater impact resistance. Note how 4 screened eye cup ports admit air to keep lenses fog-free.

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We are proud that McGraw-Hill publications were among the founders and charter members of the Audit Bureau of Circulations.

Today the Bureau numbers 3,670 members. These include advertisers, agencies, and publishers of newspapers, farm papers, general magazines and business journals such as this one. These publisher members hold their memberships and their right to display the ABC symbol in their publications only so long as they live up to the circulation standards that are established through the Bureau.

It is one thing to set up high standards; it is another to see that those standards are maintained. This latter and all-important function is performed by a staff of auditors maintained by ABC to check periodically on the circulation practices of the publisher members. When a business magazine, such as this one, joins the Bureau it agrees that the ABC auditors shall have "the right of access to all books and records." Their inspection may dig into the files of original subscription orders, payments from subscribers, paper purchases, postal receipts, arrears of payments, editorial expenses and many other significant items. Sometimes the auditors go behind the records and seek verification of purchase and payment from subscribers themselves.

The information thus obtained and certified by the Bureau then becomes available to the public and constitutes an authoritative report on the publication's circulation practices.

The advertisers and agencies benefit directly from the ABC because it provides a generally recognized factual yardstick by which the circulations of member publications can be measured and appraised. Every paragraph in an ABC report on a business publication gives the advertisers data that help them make intelligent use of the publication as an advertising medium.

But the ABC renders a service of vital concern to the *reader* as well. The Bureau audits paid circulation only, and it is through this payment, whether by subscription or newsstand purchase, that the reader keeps the editorial policy of a publication responsive to his needs. His decision to buy or not to buy records his judgment on each publication, and the ABC-audited and certified circulation reports make the sum of these judgments known to all concerned.

So the editors of ABC publications must constantly keep their editorial services up to the mark if they are to survive a competition in which the reader's right to buy or not to buy is paramount. Each paid magazine or newspaper will prosper or fail as it wins or loses the voluntary patronage of thousands or millions of readers. And—the ABC is scorekeeper in this vital contest.

Thus the publisher who submits his publication to the supervision and discipline of ABC affirms in the strongest possible manner his recognition that his primary obligation is to his readers and that he owes the standing of his publication to a voluntary demand by those readers.

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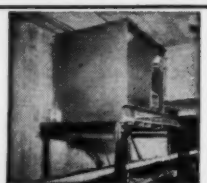

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WHERE TO BUY SECTION
They supplement other advertising in CHEMICAL ENGINEERING of products and services essential to modern chemical plant operation.

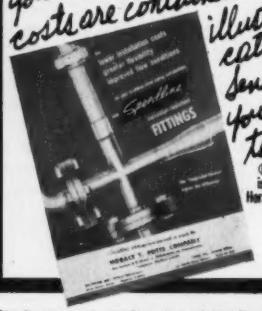
The NEW Standard in Pipeline Economy

***Speedline*® FITTINGS REDUCE INSTALLATION COSTS!**

EXCLUSIVE TANGENTIAL FEATURE allows:

- **More Clearance for Welding**
- **Easier Alignment**
- **Flanging Without Welding**

Complete details on how you can reduce your piping costs are contained in this illustrated catalog. Send for your copy today.



®SPEEDLINE is a registered Horace T. Potts Co. trademark

Distributors are located in principal cities from coast to coast

Speedline®
STAINLESS STEEL FITTINGS
manufactured by **HORACE T. POTTS COMPANY**
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- **Merchandise your advertising**
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- **Sell direct**
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R. S. ARIES & ASSOCIATES
Consultants to the Chemical Industries
New Products and Processes
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Process Analysis — Market Research
COMPLETE TECHNICAL & ECONOMIC SERVICES
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W. L. BADGER
CONSULTING CHEMICAL ENGINEER
Evaporation, crystallization, and Heat Transfer; Complete plants for salt and caustic soda; Complete Dowtherm installations.
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Chemical & Industrial Engineers
"Dependable Engineering For Profitable Operations"
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MU. 6-4712

CARL DEMRICK
Technical Translations
Send for Circular
53 So. Broadway Yonkers, N. Y.

ENGINEERING DESIGN AND DEVELOPMENT COMPANY
Design, Consulting and Construction Engineers
All Types of Chemical, Metallurgical and Power Plants Designed and Installed. Technical Reports and Start-Up Operations. Process Design.
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Specialists in Processes and Plants for Rubber and Plastics
A Complete Engineering Service including: Economic Surveys; Process Design; Installation; Contracting and Operation
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Specializing in:
Designing and Engineering of Industrial Plants. A complete Engineering Service including Economics Surveys and Installation for South America.
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Plants — Process — Equipment
DESIGN
Reports Trouble-Shooting Appraisals
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When you need a SPECIALIST in a hurry . . .

Chemical Engineering's Professional Service Section offers the quickest, most direct method of contracting consultants who may be available NOW.

KNOWLES ASSOCIATES
Chemical—Metallurgical—Mechanical Engineers
Consultation — Design
Complete Plants — Equipment
Heavy Chemicals — Ore Dressing
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THE KULJIAN CORPORATION
Consultants • Engineers • Constructors
Chemical • Industrial • Process
1200 N. Broad St. Phila. 21, Pa.
Offices Throughout the World

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Engineers
Industrial Plants
Reports Design Supervision
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Development
457 Washington Street New York 13, N. Y.

METCALF & EDDY
Engineers
Industrial Waste Treatment
Water Supply and Water Purification
Stream Pollution Investigations
Laboratory
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Engineers
CHEMICAL AND PETROLEUM PROCESS PLANTS
Design-Procurement-Construction Supervision
Start-Up
New York, N. Y. Beaumont, Texas

PATCHEN AND ZIMMERMAN ENGINEERS
Chemical, Process, and Industrial Plants
Investigations—Reports—Design—Supervision
Augusta, Ga. Atlanta, Ga. Anniston, Ala.

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From idea through pilot plant
DESIGN
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Supervision—Trouble shooting
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P.O. Box 4258 Washington 12, D. C. WEbster 5-6897

CHESTER E. ROSE
Coating & Drying of Webs
Cost Reduction
Jet Dryers
Process Development
Festoon Dryers
Consultant to Photographic Industry
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SANDERSON & PORTER ENGINEERS
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CONSTRUCTION
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CONSULTING ENGINEERS
Specializing in Sulfur & Sulfur-containing Chemicals
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J. E. SIRRINE COMPANY
Engineers
Plant Design & Surveys covering Chemicals, Electrochemical and Metallurgical Production; Trade Waste Disposal; Water Supply & Treatment; Analyses & Reports.
Greenville - - - - - - - - South Carolina

TECHNICAL ENTERPRISES, Inc.
Engineers - Consultants - Chemists
to
Chemical — Food — Pharmaceutical Industries
Complete Engineering Services
Product & Process Research & Development
SPECIALISTS IN SMALLER MANUFACTURING PLANTS
31 South St., New York 4, N. Y. WH 3-1544

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Consulting Chemical Engineer
CHEMICAL AND INDUSTRIAL PLANTS
PROCESS SURVEYS - PATENT REPORTS
24 Fifth Avenue New York 11, N. Y.
GRamercy 3-6400

THE J. G. WHITE ENGINEERING CORPORATION
Design - Construction - Reports - Appraisals
80 Broad Street, New York 4

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant
Positions Wanted
Part Time Work

Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered

Employment Agencies
Employment Services
Labor Bureaus

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The advertising rate is $19.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

$1.50 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS to CHEMICAL ENGINEERING, 33 W. 42nd St., N. Y. 36, N. Y. for November issue closing October 3rd.

METALS RESEARCH LABORATORIES

Technical Personnel Requirements

SENIOR RESEARCH ANALYTICAL CHEMIST: Ph.D. in analytical chemistry with emphasis on chemistry of metals is required for the investigation of special samples by latest analytical methods and/or new techniques. Also involved is the development of improved analytical methods for standard products. Coordination with metallurgical and engineering groups will be required to provide the maximum of information regarding reactions, reaction products or techniques. Send resume of education, experience and salary expectations to

M. L. BAAS,
Metals Research Laboratories of the
Electro Metallurgical Company,
P. O. Box 580 Niagara Falls, New York

WANTED
TECHNICAL EDITORS

To provide for its continued growth Chemical Week is seeking two additional assistant editors — preferably chemists or chemical engineers with two to three years business experience. Essential: Ability to meet people, dig out facts, interpret them intelligently and write lucidly. Please submit resume to:

PERSONNEL DIRECTOR
McGRAW-HILL PUBLISHING CO.
330 W. 42ND ST.
NEW YORK 36, N. Y.

CHEMICAL ENGINEERS

An active, confidential service!
Interview at your convenience.
Call, write or wire
GLADYS HUNTING (Consultant)
DRAKE PERSONNEL, INC.
220 So. State St. Rm. 628 Chicago 4, Ill.
HArrison 7-8600

CHEMICAL ENGINEER

Process or Project Engineer $7 to 9,000 per year for a good man. Chemical plant experience preferred. For this and other jobs.

CONTACT—Bob Poore
O'SHEA EMPLOYMENT SYSTEM
"America's Largest"
64 E. Jackson, Chgo, Ill. Tel. WAbash 2-1884

CHEMISTS—CHEMICAL ENGINEERS

B.S. to Ph.D. Beginners—Experienced
We place EXCLUSIVELY with
Chemical Companies
Call—Come In—Send 5 résumés
SELECTIVE PLACEMENT
EMPLOYMENT AGENCY
17 William Street Newark, N. J.
C. A. Reed Jr., M.Sc. S. Goodman, M.Sc.

CHEMICAL ENGINEER

Young engineer with interest in chemical technology wanted by progressive equipment designing and manufacturing company in Western Pennsylvania. Will consider recent graduate or man with up to five years' experience. Please submit record of education, experience, references and salary expected.

P-7091, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

Wanted: Graduate chemical engineer for assistant plant manager in chemical plant. Applicant must be under 32 years of age and have two years experience in distillation and reaction processes. Contact: Synvar Corporation, 415 East Front Street, Wilmington, Delaware.

EMPLOYMENT SERVICE

Salaried Positions $5,000 to $35,000. We offer the original personal employment service (established 45 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars. R. W. Bixby, Inc., 653 Brisbane Bldg., Buffalo 3, N. Y.

POSITION WANTED

Chemical Engineer. Age 34. ScB in Chem. Eng. 1942. Ten years experience as project engineer and construction superintendent, electrolytic cells a specialty, speaks Spanish and French, seeks position of responsibility in small progressive concern. PW-7642, Chemical Engineering.

MANUFACTURERS REPRESENTATIVE

Cincinnati — Louisville

Successful manufacturers representative organization now calling on aircraft and chemical process industries wants line of process control equipment and instruments.

RA-7280, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

EXCLUSIVE TERRITORIES AVAILABLE

For firms or individuals to sell and service leading manufacturers complete line of

Corrosion Proof Materials and Construction

On Commission Basis. Locations Available: Alabama, Carolinas, Georgia, Minnesota, Missouri, Virginia, Kansas.

RW-4227, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

COMBUSTION ENGINEER

For research and development of gas & oil fired burner equipment for industrial processing. This is a newly created position with many interesting possibilities.

WESTERN PRODUCTS, INC.
P. O. Box 31 New Castle, Indiana

To EMPLOYERS Who Advertise for MEN:

Frequently, when there are many applicants for a position, only the most promising letters are acknowledged. The other applicants never know whether their letters reached a prospective employer or not. These men often become discouraged, will not respond to future advertisements and even question their bona fide character.

Every Advertisement Printed in the Searchlight Section Is Duly Authorized.

You can help keep our readers interested and get better returns to your advertising in this section if you acknowledge each reply—in plain envelopes, if you wish.

Classified Advertising Division

McGRAW HILL PUBLISHING CO., INC.

"Put Yourself in his place."

CHEMICAL MARKET RESEARCH

Our expanding consulting service to the chemical process industries means we have openings for young chemists and/or chemical engineers who are looking ahead. No market research training is necessary but some industrial experience is indicated plus an active interest in the economic and marketing phases of the chemical process industries. Obviously training or experience in market research would be available.

Roger Williams Technical & Economic Services, Inc.
148 East 38th Street, New York 16, New York Murray Hill 5-5257

ENGINEERS

MAJOR EXPANSION

Creates Promising Positions
Aeronautical Engineers
Chemists
Chemical Engineers
Mechanical Engineers
Physicists

Stimulating jobs with a future in Combustion Research and Development . . . Applied Research, Development Engineering, Evaluation, Fundamental Engineering and Program Planning.

At General Electric's Aircraft Gas Turbine Development Department, there is a major permanent expansion, creating permanent positions with career possibilities as big as your own abilities. If you have a B S, M S or Ph D, and would like to work for an established industrial leader, get in touch with us. Opportunities for those with or without industrial experience in the areas of Burner Design, Combusion, Fuels, Fluid Flow, Heat Transfer and Thermodynamics.

Please send resume to:

MR. J. L. ROACH, AGT Development Dept.

GENERAL ELECTRIC

Cincinnati, Ohio

WANTED

GRADUATE ENGINEERS

EXPERIENCED OR INTERESTED IN HEAT TRANSFER

Excellent opportunity; liberal company benefits.

YOUNG RADIATOR CO.

709 S. Marquette St. Racine, Wis.

CHEMICAL ENGINEERS

Outsanding openings for graduate engineers having a minimum of 5 years experience in process development and cost estimating. Company operates on A.E.C. Laboratory in the Boston Area. Salary commensurate with experience and training. Send complete resume.

NATIONAL LEAD CO., INC.

Holton St. Winchester, Mass.

Plant Chemist

Eastern Cement plant desires chief chemist immediately. Prefer man with Degree in Chemical Engineering and experience in the manufacture of Portland Cement. Include in your reply complete details of training, experience, age and other pertinent data. All replies will be confidentially treated, and our company personnel knows of this advertisement.

P-7522, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

SANITARY ENGINEER

Opportunity available for Sanitary Engineer in an expanding pulp and paper mill located in the Middle Atlantic States. Age 25-35 years. Require man experienced in Paper Mill wastes, Paper Mill stream pollution and Paper Mill Water purification No other experience will be given consideration Good salary and advancement. Send resume of educational background and industrial experience. All replies confidential.

P-6998, Chemical Engineering
330 W. 42 St., New York 36, N Y

Procter & Gamble needs ENGINEERS

(Graduated within last 10 years)

- Permanent positions in Mechanical Research and Development, Process Equipment Design and Application, Heat and Power Equipment Design, Construction Management and other Engineering Fields.
- Salaries commensurate with education and industrial experience.
- Opportunities to grow with a leading chemical processing company —rated as one of the nation's three best-managed companies by the American Institute of Management.

For application form and further information write

Mr. T. M. Turner
Head of Employment
Engineering Division
Procter & Gamble
Cincinnati 17, Ohio

SUPERINTENDENT— ORGANICS PRODUCTION

We have an excellent opportunity for a man with a B.S. or advanced degrees in chemistry or chemical engineering as Superintendent of petro-chemicals production for a medium-sized chemical company located in the Detroit area. A minimum of seven years' supervisory experience in organics production is required. Please submit a complete resume, including salary requirements, in first letter.

P-7588, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

CERAMIST or PHYSICAL CHEMIST

With strong interest in research involving high temperature solid state reactions between unusual ceramic materials, to participate in program to develop ceramic components for atomic energy uses. Advanced degree or experience desirable. To work in modern laboratories with excellent facilities.

Reply to Manager,
Salaried Personnel Administration,

The Carborundum Company
Niagara Falls, New York

CHEMIST

Pigment manufacturer St. Louis area has opening for chemist. Right man will have opportunity to head staff in pleasant air-conditioned laboratory. Compensation commensurate with ability. Man between 30 and 35 years of age preferred. Write giving full details.

P-7372, Chemical Engineering
520 No. Michigan Ave., Chicago 11, Ill.

THE DOW CHEMICAL COMPANY

TEXAS DIVISION

FREEPORT, TEXAS

Offers Opportunities for:

Organic Chemists
Analytical Chemists
Polymer Chemists
Physical Chemists
Chemical Engineers
Mechanical Engineers

with

B.S., M.S., Ph.D. Degrees
0 to 5 Years Experience

Positions available for qualified candidates in Organic and Inorganic Research, Development, Organic and Inorganic Production, Process and Plant Design, and Analysis.

Moving Expenses Paid
Good Housing Conditions

Qualified applicants please submit resume and record of college work to:

D. M. Duguid

The Dow Chemical Company
FREEPORT, TEXAS

METALS RESEARCH LABORATORIES

Technical Personnel Requirements

CHEMICAL RESEARCH ASSISTANT: B.S. or A.B. in chemistry or chemical engineering. This assignment will emphasize application of new techniques for extraction as well as experimentation on liquid-liquid extraction of metals from ores. Send resume of education, experience and salary expectations to M. L. Baas, Metals Research Laboratories of the Electro Metallurgical Company, P. O. Box 580, Niagara Falls, New York.

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED RATE:

$1.50 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $1.50 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $14.75 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISEMENTS to N. Y. Office, 330 W. 42nd St., N. Y. 36, N. Y. for November issue closing October 3rd.

NEW AND GOOD - AS - NEW EQUIPMENT

1—Stainless Tank ±430 Chrome, vert. 7'x10' deep.
20—Jacketed Kettles—Stainless, Copper, Aluminum.
1—Day Mixer, steam jacketed, 50 gal. Sigma Blade.
1—Copper Evaporator, steam jacketed, 9'1"x3'9"
60—New Pressure Cookers, 18"x18" & 24"x28".
150—Pumps—steam and electric.
1—New Glass Nash Centrifugal Pump, 160 gpm.
1—Sulfovak Jacketed Impregnating Tank 42"x82".
1—4x8 Sturtevant Jaw Crusher.
1—Ribbon type Mixer steam jacketed.
1—Abbe Ball Mill, 36"x42" Buhrstone lined.
±316 Stainless Steel Tanks, new 100, 200 & 360 gal.
1—Nash Air Compressor, Type AL-623.
1—Manton Gaulin Stainless Homogenizer, 125 gph.
1—I&R Vacuum Pump, 5 H.P., 60'.
4—Heat Exchangers, 12" dia. 11' lg., 43 steel tubes.
1—Stokes Single Punch Tablet Machine.
1—Kennedy-Van Saun Rotary Dryer, 4'x40'.
Davenport Rotary Steam Tube Dryer, 6'x38'.
2—Stainless Steel Steam Jacketed Readco Mixers.
1—±316 Stainless Reactor, 265 gals. cap., jacketed.
Abbe Pebble & Tube Mill, 5'x22'—Buhrstone Lined.
1—Patterson Ball Mill, porcelain lined, 17"x27".
1—Patterson Ball Mill, 42x36, jacketed.
3—Dopp Kettles with agitators, 600 gal. cap.
45—Steel Tanks from 100 to 100,000 gals.
2—Large Steam jacketed Horizontal Mixers.
Robinson Pulverizer ±20, with 2 motors 10 HP each.
Robinson Ribbon Type Mixer, 30"x10'—like new.
4—Horizontal Retorts 200± w.p., A.S.M.E., from 12" to 24" dia., 4' to 12' long.
2—Crystallizers—10' long.
3—3,000 gal. Jacketed Kettles with Turbo Agitators.
1—±10 J. H. Day 300 gal. Sigma Blade Mixer. Jacketed.
6—Blackburn-Smith Jacketed Filters 20 to 160 gpm
1—Single Deck Vibrating Screen 3'x6'.
1—Jeffrey Vibrating Conveyor 15' Long.
4—Hoffman Steam Jacketed Filters.
1—Meade Mill ±2 with 7½ H.P. Motor.

H. LOEB & SON

4643 LANCASTER AVE., PHILADELPHIA 31, PA.

AVAILABLE / WANTED

CUSTOM REFINING FACILITIES . . .

- Complete Distillation Service • Distillations
- Extractions • Fractionations Drum Lots—Tank Cars
- All Types of Crude Mixtures
- By-Products, Residues, Wastes
- Contaminated Solvents

Trufiana CHEMICAL & ENGINEERING CO., Inc.

Box 426, Union, N. J. MUrdock 6-5252

HAMMER MILLS—Williams #3—14 x 19, Jeffrey Flextooth 24 x 30, Style B 42 x 24 "Miracle"
HARDINGE MILLS—2' x 8', 6' x 22", 7' x 22", 4' x 8'
PEBBLE MILLS—15 gallon jar, 40 gal (24 x 36) 345 gal (4' x 5') 660 gal (6' x 4')
CRUSHERS—ROLL—24 x 18, 30 x 16, 32 x 12, 42 x 16, Single roll Link Belt 24 x 30, McLanahan 24 x 36
CRUSHERS—JAW—6 x 9 New Holland, 11 x 26, Champion, 20 x 4" Farrel, 24 x 13 Farrel
FEEDERS—Syntron F-44 (Selenium rectifier) Mecco 42" disc, Link Belt 18" x 13' apron (New)
AUTOCLAVES—One gal S/S 1000 PSI, 54" x 6' (60 PSI—New)
SCREENS—Type Hummer 3 x 5, 4 x 4, 4 x 8 Hewitt Robbins—3 deck, Cedar Rapids 4 x 10 double
FORK LIFT—Hyster 7500#, pneumatic tires, new engine
ROTARY DRYERS—12" x 20', 40" x 30' (New) 5' x 30', 5' x 40' (New)
COMPRESSORS—20 CFM Ing. Rand, 194 CFM Gardner w/meters
VACUUM PUMP—MD 673 MD673, 1253, H 7

LAWLER COMPANY

Durham Avenue Metuchen, N. J.
Metuchen 6-0245

COMPRESSOR DIRECTORY

World's Best Rebuilts

All Makes
Many Sizes

Electric Steam Gas Diesel

AIR

for Sale or Rent Since 1902

1 CFM to 5700 CFM
1 lb. to 3500 lbs.

American AIR COMPRESSOR CORP
NORTH BERGEN, N. J.
Telephone UNion 5-4848

WANTED

WE NEED

All Kinds of Oil Refinery and Chemical Equipment, also Tanks

Write — Wire — Phone
Weinstein Co., Div. of Surplus & Salvage Co., Inc.
610 West 8th Street Jamestown, New York

WANTED—SURPLUS

Chemicals—Dyes—Drugs
Colors—Pigments—Oils—Waxes
By-Products—Wastes—Equipment

CHEMICAL SERVICE CORP.
80-04 Beaver St. New York 5, NY

MAGNETIC SEPARATORS: Exolon High Intensity, 30", type D1. 4—Dings type K, 3 roll and 4—type IR, 5 roll, with or without 3 phase, 60 cycle, 440 volt, M. G. set.

DRYER: Joy direct heat, 26" x 96".

ROD MILL: Denver 30" x 54" grate type discharge, drum type feeder, with motor and drive. NEW condition.

FEEDOMETER: Hardinge size "D" Constant Weight Feeder "Feedometer" complete with belt, speed reducer, motor, etc.

PUMPS: 2—Denver 1" Centrifugal Sand Pumps with 1½ H.P. motors.

OVERHEAD ELECTRIC TRAVELING CRANES: 10 ton capacity, 54 ft. span, 4 motor, bucket operating, cage control, 440 volt, A.C., with quantity of new parts. Other cranes A.C. and D.C., 5 to 150 tons capacity, various spans.

LOCOMOTIVE CRANE: 25 ton capacity, standard gauge, gasoline powered, cast steel trucks, air brakes, with or without 1¼ yd. Williams clam shell bucket, thoroughly modern, excellent condition. Located Minnesota. For sale or rent.

LOCOMOTIVES: 2—65 ton, diesel electric, standard gauge, thoroughly modern, excellent condition, for sale or rent.

We Buy and Sell Equipment Throughout North and Central America

A. J. O'NEILL
Lansdowne, Pa.
Phila. Phones: MAdison 3-8300 — 3-8301

2-TURBO GENERATOR UNITS

Westinghouse turbine, Max. press. throttle 340# P.S.I.G., Bleeder Station 110# P.S.I.G., Exh. 30# P.S.I.G. Satu. Steam. Ser. Nos.—12750 & 12751.

W.H. AC gens., 1563 K.V.A., 480 volts, 1880 amps., 60 cycle., 3600 R.P.M., type SO-2G135, 80% P.F., 3 ph., Ser. No.—4953392-93.

W.H. DC exc., type SK, 16 K.W., 125 volts 128 amps., 3600 R.P.M., frame 43, sty. No. 2G136.

Still on fndn. In exc. condition.
Price and further inf. on request.

PHILADELPHIA TRANSFORMER CO.
Box 566 Dalton, Pa. *Ph.: 3-4811*

Wanted

JACKETED MIXER

200 gallon working capacity Baker Perkins jacketed Mixer with sigma blades for vacuum operations.

W-7682, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

Watch—
the *Searchlight Section*
for
Equipment Opportunities

IF THERE IS

Anything you want

that other readers of this paper can supply

OR—

Something you don't want

that other readers can use, advertise it in the

Searchlight Section

You hit the DOUBLE *jackpot . . .*

1 SATISFACTION 2 ECONOMY

with BRILL

RE-NU-BILT EQUIPMENT

See Additional Listings on Page 434

DRYERS

1—Allis Chalmer's 8'x72' Rotary Kiln
2—Cummer 5'x40', 5'x30' Rotary.
1—Vulcan 4½'x50' Rotary.
1—Link Belt 6'4"x24' steel Roto-Louvre, Dryer Heresite coated.
1—Link Belt 3'10"x12' steel Roto-Louvre Dryer.
1—Devine #27 double door Vacuum Shelf, 17—59"x78" shelves.
1—Stokes Vacuum Shelf Dryer #138-H-10 44'x40" shelves.
2—Struthers Wells 5'x15' nickel clad Rotary Vacuum.
1—Devine 5'x10' steel Rotating Vacuum.
2—Stokes 30"x8', 3'x15' Rotary Vacuum.
4—Buflovak Double Drum 42"x120", 32"x120", 36"x84", 32"x72".
2—Buflovak 6' and 3' dia. Crystallizers.

FILTERS

3—Oliver Monel 8'x10', 3'x2' Rotary.
1—Feinc 5'x3' Monel Rotary Vac String.
2—Sweetland #12—72, 36 leaves.
2—Sweetland #3 all S/S.
3—Sweetland #3, #5, #7.
1—Niagara 110 sq. ft. S/S.
3—Shriver 36" P&F 42 chambers.
4—Shriver 30" P&F 30 chambers.
8—Sperry 24" P&F 16 chambers.
2—Sperry Aluminum 30" and 24".
1—Sperry 36" P&F, heresite.
12—Filter Press Skeletons, all sizes.

PULVERIZERS—CRUSHERS

1—Devine 5'x10' steel, jacketed Mill.
4—Hardinge Mills 4½x16", 5/x22", 5'x36", 6'x22", 10'x48".
4—Patterson 6'x8', 5'x6', 3'x4' brick-lined Pebble Mills.
1—Patterson 6'x8' porcelain (Berylite) Pebble Mill, 50 HP. NEW.
3—National 10"x20", 6"x12" Mills.
3—Gayco Air Separators 12', 8', 18".
3—Mikro Pulverizers #4TH, #2.

CENTRIFUGALS

1—AT&M 36" suspended 304 S/S.
1—Bird 40" Suspended, rubber.
3—Tolhurst 40", 32" Suspended, steel.
1—AT&M 36" rubber covered.
1—Fletcher 30" Suspended, steel.
1—Tolhurst 26" Suspended, steel.
1—Tolhurst 26" Suspended, rubber.
2—Sharples PN Super-D-Canters, S/S.
2—Bird 18"x28" Continuous 310 S/S.
2—Sharples C-27, C-20 S/S Super-D-Hydrators.
2—Sharples #16P Monel and S/S. Super Centrifuges.

SPECIALS

30—S/S CONDENSERS 100, 200, 400, 600, 715 sq. ft. 1" TUBES 150#PSI.
1—2500 gal. 316 S/S jacketed, agitated Reactor 5' x 15'.
4—National Carbon Karbate and Pyrex Concentric coolers cap. on BHC 1000# per hr.
1—P. & S. Two-Truck Dryer 350 sq. ft. S/S trays.
1—Swenson 4' x 2' nickel Rotary Vac Filter.
1—7' x 25'6", 347 S/S Tower 800'-10" to 18", 347 S/S piping, valves and fittings.
250—304 and 316 S/S Valves ½" to 4".
8—Buflovak 7' x 14' closed, jacketed steel Kettles, 50 psi with 10 HP Turbo Mixers 4000 gal. cap.

SCREENS

4—#82 Rotex double deck 40"x120".
1—Patterson single deck 40"x84" S/S.
1—#23 Rotex three deck 20"x80".
1—Tyler Hummer 4'x7'.

MIXERS

10—Day "Cincinnatus" double arm Sigma Blade, 660, 250, 150, 100 and 50 gals.
2—Baker Perkins 100, 50 gal. Sigma Blades, jacketed.
5—Sprout Waldron S/S. jacketed Powder Mixers, 67, 27 and 10 cu. ft.
1—Struther Wells 6'x9' S/S. jacketed.
2—Patterson 6' and 5' Steel Conical.
2—Baker Perkins 2 gal. S/S.
1—Robinson 4000# steel powder.
6—Rodgers 400 to 3000# powder.
3—Simpson Intensive Mixers #0.
8—NEW Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gallon. Pony.

TOWERS—REACTORS—CONDENSERS & TANKS

1—2800 gal. Tank 5'x18', 316 S/S.
1—Buflovak 800 gal. 347 S/S. clad, jacketed, agitated Reactor.
5—Towers: 7'x25'6, 347 S/S., 6'x63', 6'x58' chrome lined, 42"x49', 3'x53'.
4—Foster-Wheeler Karbate Heat Exchangers 188 sq. ft.
12—Heat Exchangers 50-2400 sq. ft. Admiralty & S/S.
5—Buflovak Condensers 20 to 90 sq. ft.
4—8000 gal. Horizontal Aluminum Tanks.

MISCELLANEOUS

10—Nash Vacuum Pumps TS12, H7, H6, L5, L3 MD571, #4, #2.
3—Stokes Vacuum Pumps 10 to 50 cfm.
14—Olivite, Duriron S/S Centrifugal Pumps 1" to 6".
10—Centrifugal Pumps 60 gpm to 2000 gpm, motor driven.
11—Stokes DDS2 and "R" Tablet Machines.

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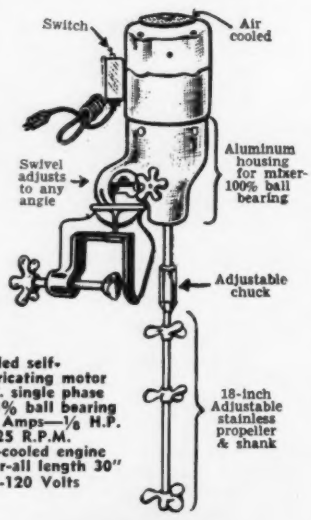

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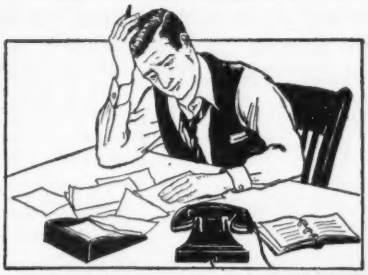

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5—24″ cast iron filters presses
1—Bird 40″ centrifuge
1—Zaremba evaporator
1—Louisville 6′ x 35′ rotary steam tubular dryer
2—2500# dry powder mixers
Kentucky—
4—5000 gal nickel clad tanks
2—500 gal nickel clad mixing tanks
1—600 sq. ft. 2 effect nickel evaporator
Henderson, Nev.
1—Worthington 210 ton refrigeration unit
Bishop, Tex
1—Eimco 4′ x 1′ rotary vac filter

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Devine #12 & #23 Vac. Shelf Dryers.
1—Stokes 2′ x 6′ Rotary Vac. Dryer.
2—Albright-Neil 4′ x 9′ Atmos. Drum Dryers.
1—Buffalo Vac. Drum Dryer 24″ x 20″.

CENTRIFUGALS & CENTRIFUGES
4—Tolhurst 40″ Suspended Type Centrifugals.
8—Centrifugals 12″, 30″, 40″ & 48″ Steel, Copper, Stainless & Rubber Lined.
6—Sharples Centrifuges #SA Stainless. Also #6.
3—De Laval Multiple Clarifiers #200, 300 & 301.

FILTERS
#2 Sweetland Filter 12 Stainless Covered leaves.
1—Vallez 41 Stainless Covered Leaf Filter, type 49.
Sperry & Shriver 12″ to 38 sq. iron & wood.
Gen. Amer. 2′ x 1′ Rotary Vac. Filter.

KETTLES & TANKS
Pfaudler 250 & 500 gal. Glass Lined Kettles.
1—Doop 350 gal. C.I. Jack. Vac. Kettle.
Devine & Stokes Imprsg. Units 30″ & 36″ dia.
Devine 1000 gal. closed Jack. Steel Kettle.
1—2300 gal. vert. agit. Jack. Steel Kettle.
8—Jacketed Kettles 50 to 2300 gals.
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2—500 gal. vert. Glass Lined Tanks.
50—Stainless Alum., Copper, Glass & Lead Lined Kettles & Tanks. Also new Stainless.

PULVERIZERS & MILLS
4—Mikro Pulverizer #2SH, #2TH, #4TH.
Patterson 30″ x 42″, 4′ x 5′ & 6′ x 4′ Pebble Mills.
Abbe 30″ x 30″ Pebble Mill.
Abbe 37″ x 30″ Chrome-Mang. Ball Mill.
#1 Raymond Automatic Pulverizer 20 H.P. motor.
1—Raymond #00 Pulverizer 30 H.P. Complete.
2—#0000 Raymond Mills.
Sturtevant #0, 18″ Hinged Hammer Mill.
Jeffrey 18″ x 18″ Single Roll Crusher.
Buchanan 5″ x 12″ Jaw Crusher.
Day Hercules Spike Crusher 1½ HP. motor.
Hammer Mills & Pulverizers 3 to 50 H.P.
1—Schutz-O'Neil 20′ Pulverizers. Also #1.
Williams #3 & 2nx Hammer Mills.
1—Robinson 18″ x 22″ Attrition Mills.
1—Lehman 4 Roll W.C. 12 x 36″ Steel Mill.
3—Steel 3 Roll Mills 9″x32″, 12″x30″ & 16″x40″.
1—9″ x 24″ 3 pr. high steel Roller Mills.
3—Houchin 18″x36″; 4 Roll Granite Stone Mills.
Ball & Jewell Rotary Cutters Lab. #1 & #2.
2—U. S. & Premier 1½ H.P. Colloid Mills.

MIXERS & SCREENS
Lancaster 6′ dia. Vert. Mixer 25 H.P.
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Kent 3 HP. Continuous Dry Mixer.
Heriz. Mixers single & double arm to 200 gal.
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Read 40 and 80 qt. vertical Mixers.
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Gould 75 HP Centrifugal Pump. 250 PSI.
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1—Bird Stainless Steel 48" suspended type Centrifuge with perforated basket, plow and explosion proof motor.
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2—Sharples Type 316 Stainless Steel Centrifuge, Model D2.
1—DeLaval Type 316 Stainless Steel Multi-Matic Centrifuge.
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1—Vulcan 7' x 120' Rotary Kiln Complete.
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1—3' x 12' Stainless Steel Rotary Vacuum dryer.
1—Steel and Alloy 3' x 15' Heresite-lined-Rotary Vacuum Dryer.
1—Stokes Rotary Vacuum Dryer, 30" x 8'.
1—Buflovak 32' x 90" Double Drum Dryer.

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- 1—Baker Perkins 100 gallon Double Arm Sigma Blade Jacketed Mixer, Hydraulic Tilt.

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1—Sperry Wooden Plate and Frame Filter Press, 12" x 12", 15 chambers.

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1—Day Cinnatus 200 gal. sigma blade mixer.
1—Banbury Mixer, midget size with 2 HP motor.
1—Day Stainless Steel Double Arm Jacketed Sigma Blade Mixer, 50 gal.
4—Simpson Intensive Mixers #0.

MISCELLANEOUS

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2—3'x7' Vert. Steel ASME 25 psi.

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1—Lawrence Vert. 316 S/S 50 gpm 107' hd 5 HP
1—Lawrence Vert. 316 S/S 10 gpm 27' hd 1 HP
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2—I.R. 1000 gpm Series 5CRVL 30 HP
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1—Link Belt 316 S/S 6" D.x16' closed screw
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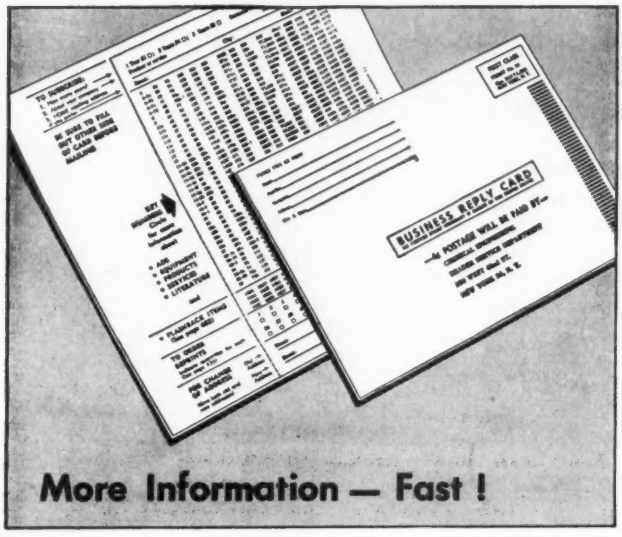

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Index to Chemicals & Equipment

Find it tough to keep up with chemical products and equipment? You can use this master index as a quick way to spot exactly what's in each issue on any particular item.

What It Contains . . .

Here's your complete index to the chemicals, materials, equipment and services advertised in this issue, announced in the Chemicals & Raw Materials and Process Equipment News departments, or listed in this issue's Guide to Technical Literature.

What the Code Means . . .

Each item has a code that's the key to its location in this issue. The numerals show the page where you'll find the item mentioned. The letters L (left), R (right), T (top) B (bottom) locate ad positions on the page; the letters a, b, c and A, B, C identify items on a page or in an ad.

For More Information . . .

You can get more information on any product listed in this directory by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, then mail to us. Answers will come to you direct from the companies manufacturing the products.

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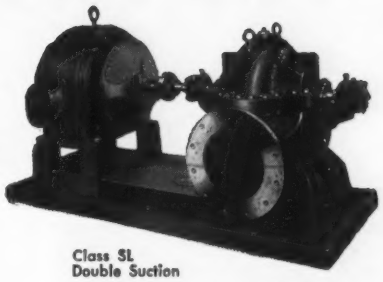

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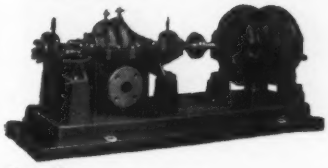

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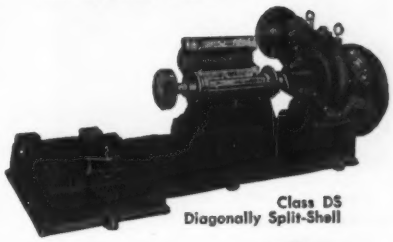

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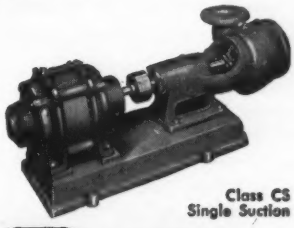

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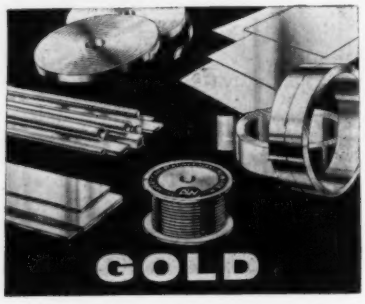

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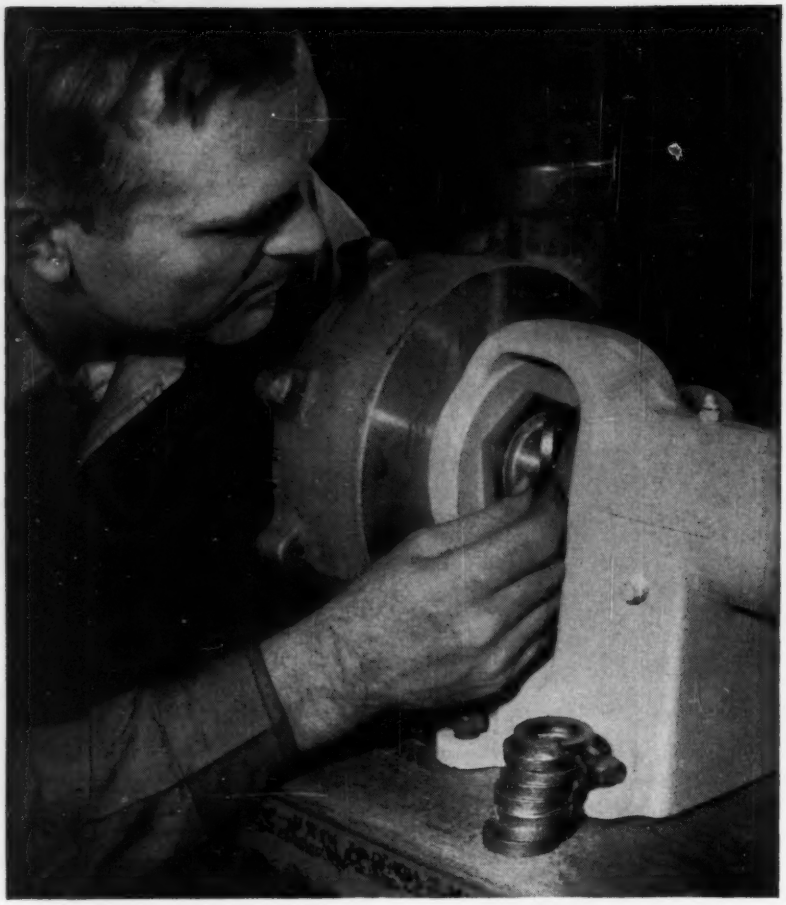

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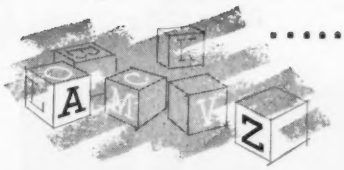

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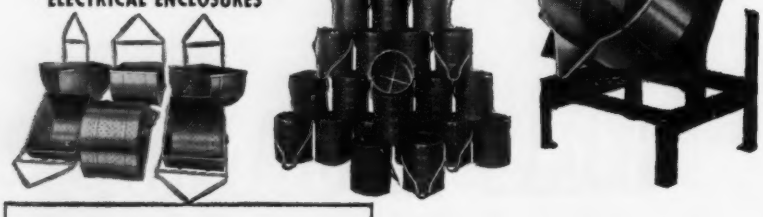

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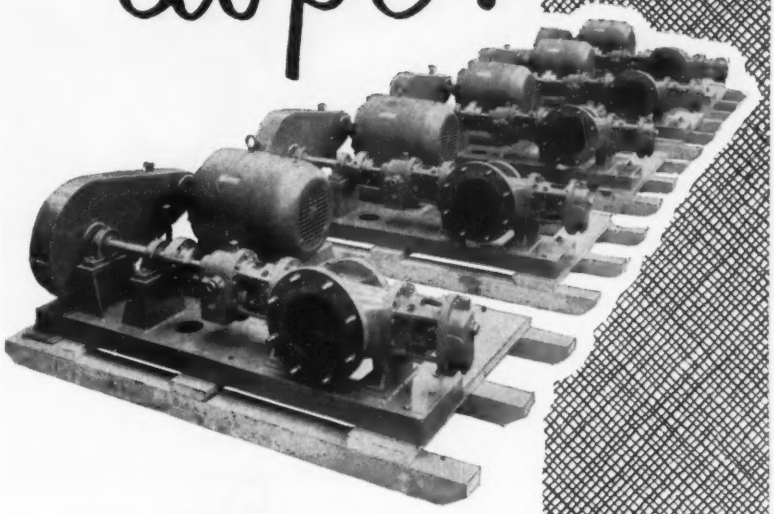

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CQ-8

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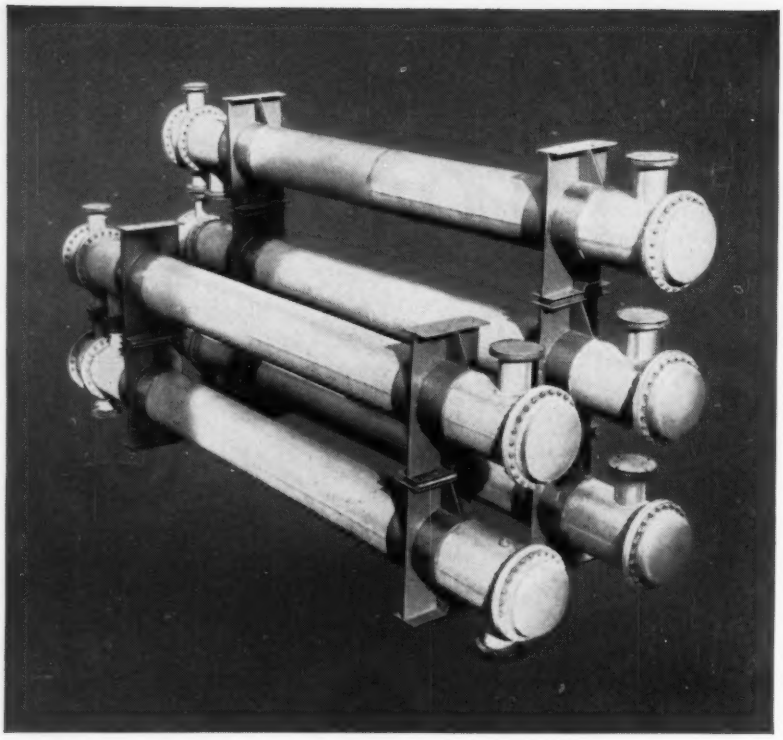

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CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

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Flashback

To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The index below repeats the editorial listings only on chemicals, equipment and service featured last month in New Equipment and in Chemicals and Raw Materials. Use the postcard (p. 485) for more information on any items.

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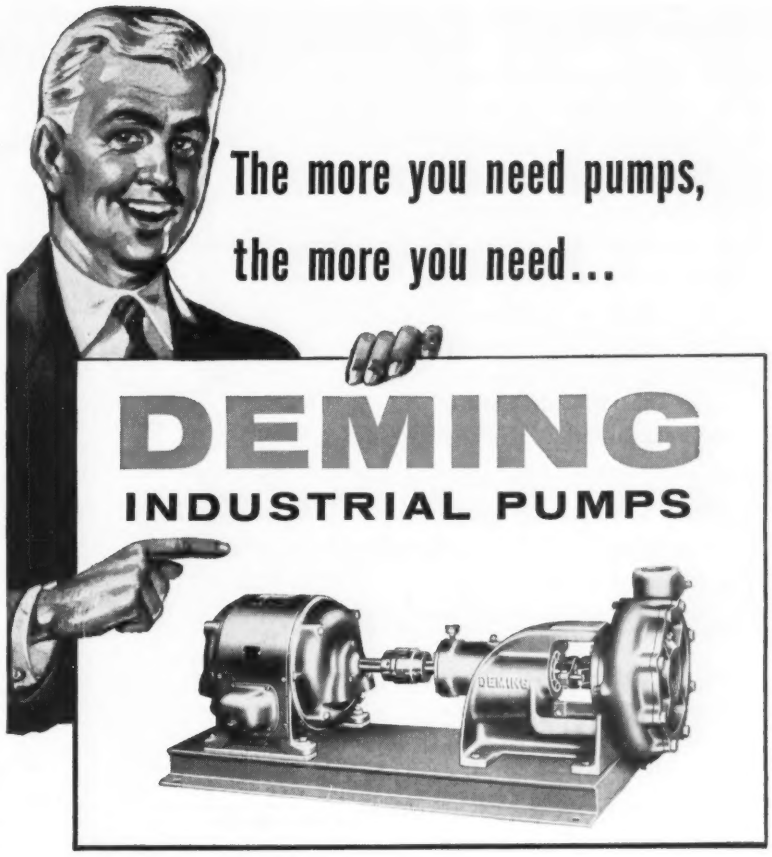

here's an example: Optional features of the Deming Fig. 4011 Centrifugal Pump (shown above) extend its scope of uses to handling a wide variety of different kinds of liquids . . . corrosive or non-corrosive. In many cases, this versatile pump eliminates the need for higher-cost pumps built entirely of corrosion-resistant metals. Other optional features include a choice of impellers and either stuffing box, or mechanical seal construction. BULLETIN No. 4011 explains this popular Deming Pump. Send for copy.

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- Centrifugal Pumps with separate liquid end
- "Motor-Mount" Centrifugal Pumps
- Split case Centrifugal Pumps
- Self-priming Centrifugal Pumps
- High pressure Multi-Stage Pumps
- "Oil-Rite" Duplex and Triplex Pumps
- Condensation Return Units
- Vertical Turbine Pumps
- Vertical Sump Pumps
- Vertical Sewage Pumps
- Submersible Pumps

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Guide to Technical Literature

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What It Contains . . .

This is a comprehensive listing of the latest literature you can now get from manufacturers on chemicals, equipment and services in all fields of interest to chemical engineers. It lists new publications just released, in addition to technical literature mentioned in the advertisements in this issue. The latter are identified by an asterisk (*) along side the company name.

For More Information . . .

You can get—and get fast—more information on any publication listed in this guide by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, fill in your name and address, then mail to us. Ask for as many as you need. Answers come to you direct from the companies putting out the literature.

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Acetoacetarylamides.....Furnishes technical information on company's line of acetoacetarylamides. Includes physical properties, applications, physiological properties, etc. Request literature reference, No. F-8259.
446A Carbide & Carbon Chem.

Acetyl Peroxide.....A safe method of isolation of acetyl peroxide. Relatively pure acetyl peroxide may be isolated from its commercial solvent solution by vacuum distillation. For complete data refer to Bulletin No. 28.
446B Buffalo Electro-Chem. Co.

Acid, Chromic.....72 p. Handbook covers chromic acid & its many metal-finishing applications. Subjects discussed range from physical & chemical properties to chromium plating formulas, specifications & equipment.
446C Diamond Alkali Co.

Acid, Dibasic.....New technical reference on Oronite Isophthalic. Includes information on: chemical and physical properties; advantages; reaction characteristics; isophthalic alkyds; etc. Bulletin No. 10.
446D Oronite Chem. Co.

Acid, Gluconic.....New, index-type, technical reference outlines uses & properties of gluconic acid. Includes charts, reactions, derivatives, applications, assay data, specifications, etc. Booklet No. 33.
446E Chas. Pfizer & Co.

Acid, Peracetic (40%).....Chemical and physical properties of peracetic acid are discussed and examples of typical reactions and uses given. Other data pertains to precautions in handling material. Bulletin No. 4.
446F Buffalo Electro-Chem. Co.

Acid Phosphates, Alkyl.....Available in quantities ranging from experimental to semi-commercial — methyl acid phosphate—n-Butyl acid phosphate—amyl acid phosphate—iso octyl acid phosphate—etc. Data & samples.
TL351 *Oldbury Electro-Chem. Co.

Acid, Phosphomolybdic.....Offers reprint, "Contribution to the Chemistry of Phosphomolybdic Acids, Phosphotungstic Acids, & Allied Substances." Preparation, analysis & analytical uses of these complex acids.
446G Climax Molybdenum Co.

Acid, Silicic SL.....Fine, white, bulky powder; odorless. Used in the manufacture of silicate phosphors for fluorescent and television tubes. Offers complete details in company's Technical Information Sheet.
446H Mallinckrodt Chem. Wks.

Acid, Sorbic.....Sorbic is a refined sorbic acid company sells for use in foods. It is an important new selective inhibitor for molds & yeast. Covers properties, solubility in various solvents, etc. Book F-8526A.
446I Carbide & Carbon Chem.

Acrylic Esters.....Advance technical information on several acrylic esters. Includes data on their physical properties, net container contents, reactions and handling precautions. Request reference No. F-8528.
446J Carbide & Carbon Chem.

Acrylonitrile.....Comprehensive information on acrylonitrile includes types of reactions, applications, physical properties, specifications, net container contents, physiological properties. Book No. F-8381.
446K Carbide & Carbon Chem.

Aldehydes.....Fully illustrated, 38 p. catalog presents the latest data on aldehydes & dialdehydes, including physical properties, shipping, physical property charts & graphs, & test methods. Reference F-5278C.
446L Carbide & Carbon Chem.

Aliphatic Nitrogen Compounds.....Illustrated, 48 p. fully describes line of aliphatic nitrogen compounds for emulsifying—neutralizing—synthesizing—dissolving—saponifying. Request Booklet No. F-4770C.
145b *Carbide & Carbon Chem.

Alkyl Benzyl Triethyl Ammonium Chloride.....Describes Emcol E-11: uses (deodorant, sanitation, laundry, etc.); chemical & physical properties; general data; bacteriology. Technical Bulletin No. 45.
446M Emulsol Chem. Corp.

Alumina, Activated.....“Activated Alumina Maintenance Program—Power System Oils” gives latest developments on use of activated alumina for maintenance of insulation oil and lubricants. 120 p.
44 *Aluminum Co. of America.

Alumina, Calcined, Ceramic Grade..... Specially processed for maximum consistency and minimum shrinkage. Uses include: kiln furniture; chemical porcelain; insulator bodies; whiteware; etc. Data and samples.
446N Reynolds Metals Co.

Brake Fluid, Hydraulic.....Announces availability of an illustrated, 8 p. reprint describing hydraulic brake fluid SAE 70R. Includes heavy-duty type (SAE 70R1) & moderate-duty type (SAE 70R2). Book F-40002.
446O Carbide & Carbon Chem.

Butyrolactone.....Powerful organic solvent for polyacrylonitrile, cellulose acetate, polystyrene, etc. Selective solvent for acetylene in natural gas. Announces the availability of technical information and samples.
446P General Aniline & Film Corp.

Calcium Carbonates, Precipitated..... “Diamond Precipitated Calcium Carbonates for the Rubber Industry”—36 p. reviews application of precipitated calcium carbonates as fillers for natural rubber compounds.
446Q Diamond Alkali Co.

Calcium Gluconate USP Powder.....An ingredient in many pharmaceutical preparations. Calcium gluconate is used almost exclusively for treatment in calcium deficiency in humans & animals. Technical Information Sheet.
446R Mallinckrodt Chem. Wks.

Carbon, Activated.....Pittsburgh Type BPL granular activated carbon designed to solve vapor phase adsorption problems more efficiently & at lower cost than and other similar material. Samples & data.
247 *Pittsburgh Coke & Chem. Co.

Catalysts.....You benefit with Girdler catalysts: custom design matches your needs; technical service helps you save; quality control assures uniformity; etc. For complete information, request Bulletin G-260.
336 *Girdler Co.

Charcoal.....Company makes available upon request descriptive literature, product samples and price information on their line of charcoal . . . Royal Oak Brand hardwood charcoal. Product is available in quantities.
447A Crossett Chem. Co.

Chelating & Sequestering Agents..... Catalog gives a full description of effect & use of "Tetrines," which chelate & sequester contaminating polyvalent metallic ions which affect emulsion stability.
447B Glyco Products Co.

Chemicals, Aluminum.....Offers a growing family of superior quality aluminum chemicals. Includes information on calcined alumina, activated alumina, alumina trihydrate, aluminum dross, aluminum powders, etc.
96 *Reynolds Metals Co.

Chemicals, Aromatic & Aliphatic..... Catalog describes aliphatic & aromatic chemicals . . . as well as cellulose products & inorganic chemicals. Includes photographic illustrations & detailed tabular material.
447C Eastman Chem. Products

Chemicals, Biological.....New, 24 p. Specification & Price Catalog for rare sugars & other biological chemicals. Includes sugar derivatives, amino acids, etc., now available in bulk & laboratory quantities.
447D Pfanstiehl Labs.

Chemicals, Chromium.....Spiral-bound, 36 p. Handbook covers general use & applications of Diamond bichromate of soda, chromic acid, sodium chromate & bichromate of potash in more than 17 different industries.
447E Diamond Alkali Co.

Chemicals, Furfural.....Product reference contains general information about company's line of QO chemicals. Covers data on furfural, furfuryl alcohol, tetraphydrofurfuryl alcohol, etc. Bulletin 201-A.
66-7 *Quaker Oats Co.

Chemicals, Metal Finishing ..... New concise descriptions of twenty series of Enthone's special products: alkaline cleaners, stripping compounds, water displacing compounds, etc. Request illustrated Form No. 16599.
447F Enthone, Inc.

Chemicals, Molybdenum ..... Company announces the availability of an informative reprint covering their product line . . . a commodity review on production and uses of molybdenum chemicals. Bulletin No. Ch-7.
447G Climax Molybdenum Co.

Chemicals, Organic.....Company publishes an "Organic Chemical Catalogue," one of a series of brochures describing Antara's products. Chemicals listed are produced in commercial or semi-works quantities.
447H General Aniline & Film Corp.

Chemicals, Organic ..... "More Tales from the Alembic" is a new booklet of "calm musings" about some of the 3,500 organic chemicals available in limited quantities for science and industry. Illustrated, 28 p.
447I Distillation Products Ind.

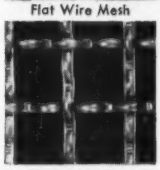
Chemicals, Peroxygen ..... Modification methods based on the use of hydrogen peroxide, peracetic acid, and persulfates are described in detail. Also contains numerous literature references. Bulletin No. 27.
447J Buffalo Electro-Chem. Co.

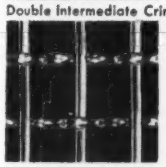
Chemicals, Process.....Valuable letter-size Folder keeps process chemical information handy. Contains availability charts of light metal compounds, heavy metal compounds, acids, etc. & full price schedules.
60-1 *J. T. Baker Chem. Co.

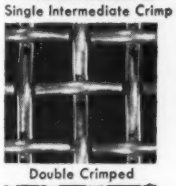
Defoamers, Silicone.....Defoamers have proved their efficiency and versatility in countless applications. Offers a new booklet with complete information on Dow Corning Antifoam agents plus a product sample.
R355 *Dow Corning Corp.

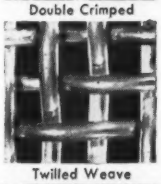
* See explanation on p. 446

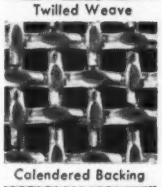
Flat Wire Mesh

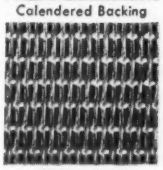

Double Intermediate Crimp


Single Intermediate Crimp


Double Crimped

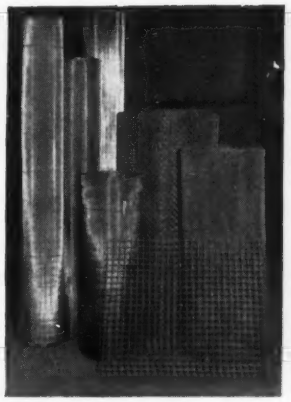

Twilled Weave

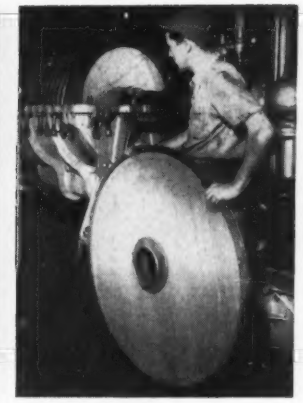

Calendered Backing


Oblong Mesh

Plain Dutch Filter

Twilled Dutch Filter





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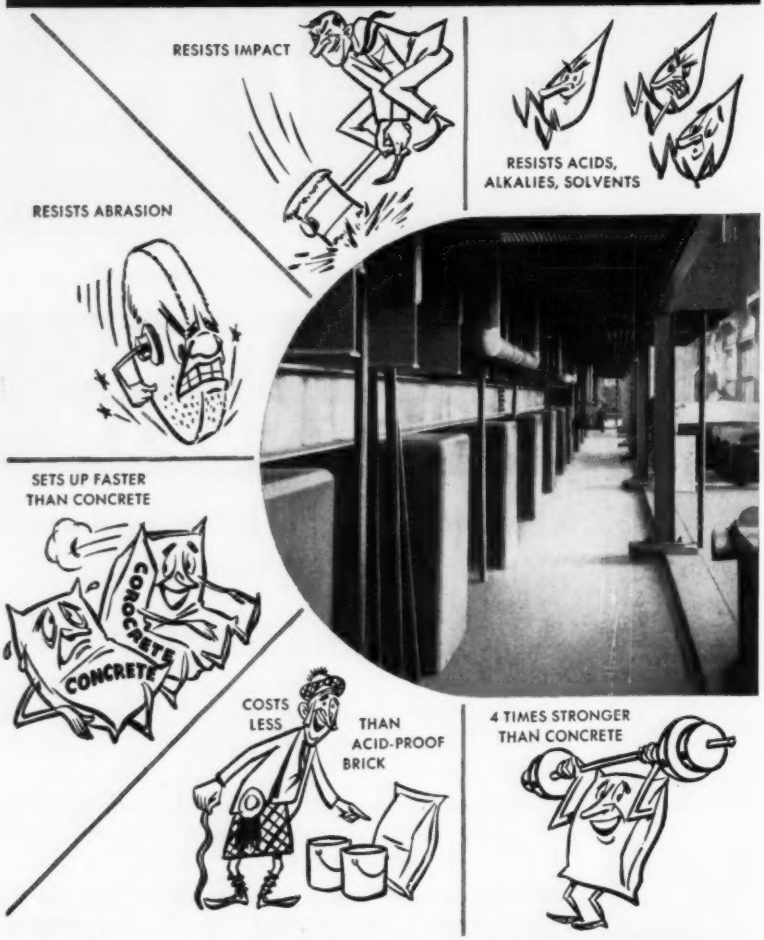

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LITERATURE . . .

Dibromodimethyl Hydantoin ..... Data on a new organic brominating agent, now available in commercial quantities. Lower in cost, more stable & more reactive than other agents. Request samples & specifications.
448A Glyco Products Co.

Diethylene Triamine.....Make new & better products with diethylene triamine—synthetic rubber . . . surface coatings . . . textile specialties . . . metal & metal working...etc. Reference No. F-8163.
145a *Carbide & Carbon Chem.

Ether Anhydrous AR ..... Perfectly clear, colorless liquid; clean characteristic odor of ethyl ether, free from foreign odor. Purest diethyl ether commercially available. Details in Technical Information Sheet.
448B Mallinckrodt Chem. Wks.

Ethylene Glycol.....Technical literature covers ethylene glycol—a low-volatile, hygroscopic liquid. Includes physical properties, solubilities, specifications, shipping data, etc. Request reference No. F-8327.
448C Carbide & Carbon Chem.

Flavors.....Illustrated, 24 p. describes Fritzche flavors for every purpose. Includes: genuine fruit extracts concentrated; fruit flavors with other natural flavors; Fritzbro fruitbases imitation; oleoresins; etc.
448D Fritzsche Bros.

Formaldehyde.....U. F. Concentrate-85 is highest concentration of liquid formaldehyde commercially available ...59% formaldehyde and 26% urea in a water solution. Request samples and valuable Folder.
133 *Nitrogen Div. AC&D.

Fullers Earth.....Covers thickening & gelling of organic & aqueous systems with Permagel—a purified, grit-free colloidal Attapulgite which imparts outstanding thixotrophy & heat stability. Bulletin No. SD-30.
448E Minerals & Chem. Corp.

Glutaraldehyde ..... Glutaraldehyde, a highly reactive derivative of acrolein, is supplied as a stable, aqueous solution having a mild odor and a light color. Literature includes physical properties. No. F-40005.
448F Carbide & Carbon Chem.

Glycerine.....Offers valuable booklets including: "Glycerine Alkyds Tailored to Need" (20 p.); reference on glycerine standards & specifications (12 p.); booklet covering properties & applications (16 p.).
89 *Glycerine Producers' Assoc.

Gums.....Data on newly available base-polymers for silicone rubber stocks. Silastic 401 & 440 Gums offer greatly reduced compounding time & increased temperature stability of compounded stocks. Reference No. 1-204.
448G Dow Corning Corp.

Hydrogen Peroxide.....Descriptive reference contains general information on properties, reactions and uses of hydrogen peroxide solutions of 27.5% to 50% concentration. Request Product Bulletin No. 2.
448H Buffalo Electro-Chem. Co.

Iron Oxides, Red.....Reds—more of them . . . and better made. Included are pure red iron oxides—red iron oxides—venetian reds. For complete information on company's line, request descriptive literature.
352 *C. K. Williams & Co.

Lanosterol.....Lanosterol is a fatty, alcoholic component of Lanolin and forms the greater part of the methanol insoluble matter of wool wax alcohols. Data on Lanster brand pure lanosterol.
448I Croda, Ltd.

Latices ..... New Bulletin describes Chemigum Latex 236 and 246: the two main particulars, particle size and stabilization, which make them different from other latices; and an analysis of their properties.
448J Goodyear Tire & Rubber Co.

* See explanation on p. 446

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EXCLUSIVE FEATURES

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2. Can be vertically or horizontally mounted.
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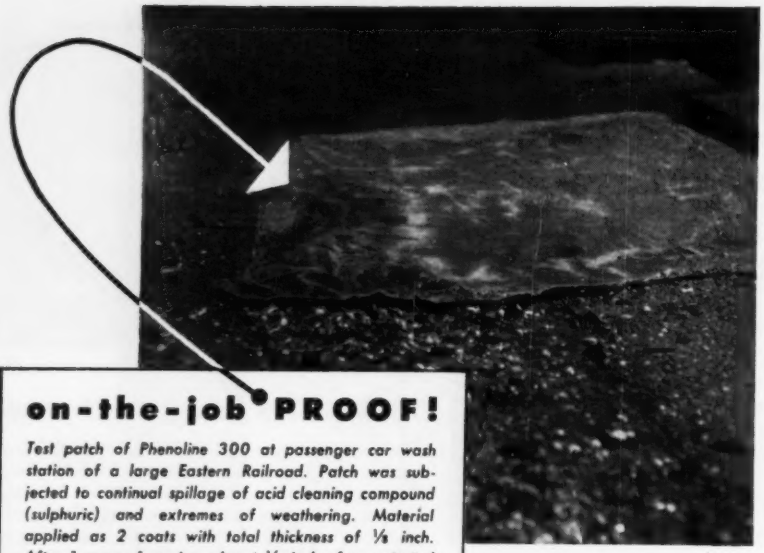

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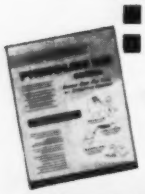

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LITERATURE . . .

Lithium ..... Interesting report, "Life with Lithium," presented in view of spectacular rise of lithium from an obscure chemical element to a multi-million dollar business in the space of half a dozen years. 24 p.
450A Foote Mineral Co.

Magnesium Aluminum Silicate, Colloidal .....Literature includes: physical properties; chemical analysis; preparation, viscosity, and properties of Veegum water dispersions; applications; etc. Bulletin 122.
450B R. T. Vanderbilt Co.

Maleic Esters.....Offers technical literature describing the physical properties, reactions, applications, availability, and net container contents of company's line of maleic esters. Reference No. F-7354.
450C Carbide & Carbon Chem.

Methanol.....Company announces the availability upon request of descriptive literature, product samples and price information on their line of methanol. Denaturing grade . . . good color and odor. Tank cars or drums.
450D Crossett Chem. Co.

Methyl Chloride.....12 p. covers line of methyl chloride, methylene chloride, chloroform & muriatic acid. Each product is summarized, its specifications listed, its uses enumerated. Shipping containers are also given.
450E Diamond Alkali Co.

N-Methyl-2-Pyrrolidone ..... Powerful organic solvent for acrylonitrile polymers & copolymers, cellulose triacetate, etc. Selective solvent for acetylene in natural gas. Technical information & product samples.
450F General Aniline & Film Corp.

Molding Materials, Alkyd ..... Characterized by excellent dimensional stability, electrical characteristics & moldability, alkyd materials find wide industrial use. Describes 3 types—granular, putty, glass reinforced.
450G Barrett Div.

Molybdenum.....Announces the release of product literature, "Climax Methods of Analysis." Features analytical procedures for the determination of molybdenum and the impurities in various molybdenum compounds.
450H Climax Molybdenum Co.

Niacinamide USP Powder.....Features valuable uses: in pharmaceutical preparations; as a specific for treatment of pellagra; to enrich various food products; etc. Complete details in Technical Information Sheet.
450I Mallinckrodt Chem. Wks.

Octylphenol & Nonylphenol.....16 p. literature reference describes line of octylphenol and nonylphenol: physical properties; uses; chemical reactions; and a complete bibliography. Request copy of Booklet SP-98.
450J Rohm & Haas Co.

Paraffins, Chlorinated.....68 p. Manual is a technical treatise on Chlorowax 40, a liquid chlorinated paraffin, & Chlorowax 70, a resinous chlorinated paraffin. Describes properties, characteristics, features, etc.
450K Diamond Alkali Co.

Pentaerythritol.....Position of PE relative to other polyols—fundamental considerations leading to its increasing use—technical advantages in terms of cost—explained in "Economics of Hercules Pentaerythritol."
450L Hercules Powder Co.

Piperazines & Pyrazines ....A literature survey covering the reactions and applications of these compounds. Pertinent data extracted from 177 sources provides a quick review of their chemistry. 33 p. booklet.
450M Wyandotte Chem. Corp.

Polycyclic Hydrocarbons ..... Literature describes polycyclic hydrocarbons (pyrene, phenanthrene, fluoranthene): physical properties of current production; uses & suggested applications; etc. Book No. F-8942.
450N Carbide & Carbon Chem.

* See explanation on p. 446

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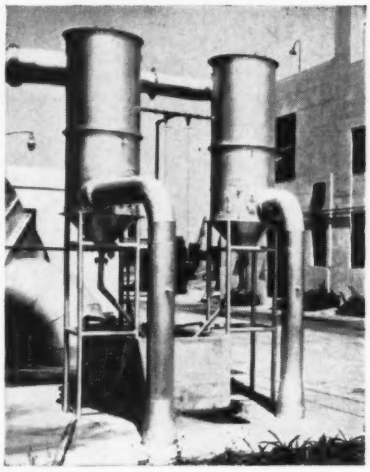

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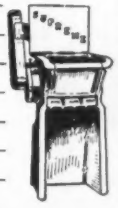

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LITERATURE . . .

Polyvinylpyrrolidone ..... Binder, stabilizer, detoxifier, protective colloid, thickener, film former. Physiologically compatible. Wide solvent range. Announces the availability of technical information and samples.
452A General Aniline & Film Corp.

Potassium m-Bisulfite Granular..... White, free-flowing crystalline granules; slight odor of sulfur dioxide. Widely used in food and beverage industry. Full details in company's Technical Information Sheet.
452B Mallinckrodt Chem. Wks.

Propylene Glycol.....Comprehensive literature includes applications, physiological properties, specifications, physical properties and solubility data for propylene glycol. Request 16 p. reference, No. F-8738.
452C Carbide & Carbon Chem.

Repellents, Fly.....Crag fly repellent is a butoxypolypropylene glycol which has proven to be a valuable ingredient of dairy and livestock sprays. Includes data on properties and formulations in Book F-8425A.
452D Carbide & Carbon Chem.

Resins.....Exon 470 combines excellent water, grease & chemical resistance with stability to heat & light & unusual resistance to weather & abrasion. Makes available descriptive product literature.
296 *Firestone Plastics Co.

Resins, Cashew Nut Shell Liquid..... Illustrated Folder describes the applications of cashew nut shell liquid resins. Includes: brake linings and clutch facings; cements and adhesives; laminated boards; etc. 8 p.
452E British Resin Products, Ltd.

Resins, Heat-Resistant.....Epocast 6 is newest addition to Epocast line of resins. Though relatively new it has shown remarkable heat resistance, superior to all other resins of its class. Tech. Bulletin EP-55-47.
452F Furane Plastics.

Resins, Polyvinyl Chloride.....Describes Firestone Exon 402-A—a polyvinyl chloride resin specifically designed for unplasticized rigid applications. Complete data on properties. Sales Service Bulletin No. 38.
452G Firestone Plastics Co.

Resins, Splining.....Epocast H-861-A, a thixotropic paste resin, has been evaluated at various aircraft companies and has proven to be the best of its kind. Find complete data in Technical Bulletin EP-54-35.
452H Furane Plastics.

Silicon Dioxide ..... Describes CAB-O-SIL, a new raw material developed for use in reinforced plastics industry to eliminate certain problems now encountered in molding & fabricating operations. Report CP1a-1.
452I Godfrey L. Cabot, Inc.

Sodium Lignosulfonates ..... Literature describes Polyfons . . . used to stabilize fire-fighting foams of the chemical type (sodium bicarbonate & alum, generating carbon dioxide). Technical Bulletin No. 304.
452J West Va. Pulp & Paper Co.

Sodium Silicates ..... 20 p. pocket manual describes Diamond sodium silicates, furnishing data on each product covering its principal physical properties, major industrial applications, the basic advantages, etc.
452K Diamond Alkali Co.

Solvents.....Assure controlled evaporation. In paint & surface coating industry . . . solvents offer precise characteristics to meet your most exacting requirements. Full data on characteristics & specifications.
85 *Esso Standard Oil Co.

Solvents.....Describes Celanese Solvent 203 . . . a latent solvent for lacquers & thinners—a brake fluid component —economical replacement for normal butyl alcohol. Covers properties, specifications, etc.
452L Celanese Corp. of America

* See explanation on p. 446

Solvents, Petroleum Aliphatic.....Offers solvents for every industrial need. Features include: special blending; laboratory purity; overnight delivery; technical assistance; etc. Folder gives typical specifications.
453A Modern Mineral Solvents.

Sprays, Dairy & Livestock ..... Technical information describing Emulsifiable Concentrate F-21, with Crag fly repellent. Includes data on ingredients present, test results and directions for use. Literature F-8849.
453B Carbide & Carbon Chem.

Sulphur Dioxide.....A versatile chemical reagent for industry, sulphur dioxide can be used as a reducing or bleaching agent, preservative, antichlor, neutralizer, pH control. Details in "Virginia SO_2" Folder.
83 *Virginia Smelting Co.

Surface Active Agents.....Bulletin offers data on chemical & physical properties & uses of Polyethylene Glycol 400 Monolaurate—a non-ionic surface active agent, used primarily for improving latex paints.
453C Glyco Products Co.

Surface Active Agents.....Makes available a report of toxicity studies on D-40 and Oronite Wetting Agent. Included are sections on: acute oral toxicity; subacute feeding in young rats; skin toxicity; etc. 10 p.
453D Oronite Chem. Co.

Surface Active Agents.....Industry has been finding more & more use for versatile non-volatile surface active agent as such, as salts or oil-soluble soap form. Request literature & sample of Alkaterege-C.
147 *Commercial Solvents Co.

Surfactants.....Oronite surfactants offer utmost in uniformity & quality. New Alkane Technical Bulletin available to those interested in processing finished detergents from the basic raw material.
121 *Oronite Chem. Co.

Triols.....Technical data on Hexanetriol-1, 2, 6 & Triol-230, stable, high-boiling liquids containing three hydroxyl groups. Includes physical properties, net container contents & solubility data. Book F-7779.
453E Carbide & Carbon Chem.

Vinyl Acetate ..... Detailed literature provides technical information on Niacet vinyl acetate. Includes physical & chemical properties, applications, operating procedures, etc. Request reference No. F-7575A.
453F Carbide & Carbon Chem.

Waxes.....Company announces the release of a new reference entitled, "Wax Facts," which contains valuable market information, ideas for formulation & general news relating to waxes & allied materials.
453G Dura Commodities Corp.

Waxes, Synthetic ..... Reference describes prevention of solder oxidation with a synthetic wax, "Glycowax S932" . . . acts as a coating for solder, preventing scum formation & oxidation. Bulletin & product samples.
453H Glyco Products Co.

Construction Materials

Adhesives....."Adhesive Bonding" features illustrations of such typical adhesive applications as: aircraft aluminum honeycomb construction; fin tubing heat exchanger assemblies; etc. Illustrated, 8 p. Manual.
453I Rubber & Asbestos Corp.

Alloys, Titanium.....New product bulletin describes the MST 6A1-4V titanium alloy. List metallurgy & chemistry of the alloy, properties & recommended heat treatment, forging & welding procedures.
453J Mallory-Sharon Titanium.

* See explanation on p. 446

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LITERATURE . . .

Aluminum.....Process Industry applications of aluminum for producing everything from beer to bomb shells are analyzed in illustrated, 80 p. book, "Process Industries Applications of Alcoa Aluminum."
78 *Aluminum Co. of America

Cements, Insulating.....Eagle-Picher Super "66" really sticks, makes difficult jobs easy, usually requires no reinforcing on applications up to 1½ inches thick. Makes available a free product sample.
51 *Eagle-Picher Co.

Coatings, Protective.....New 19 p. report on comparative properties of protective coatings. Contains information on 14 coating types, physical & chemical data & a section on the selection of coatings.
454A Atlas Mineral Products Co.

Coatings, Protective.....Now . . . your own painter can "cold-galvanize" and steel surface with Dimetcote (100% inorganic zinc coating) . . . any place—anywhere—anytime. Request Dimetcote Technical Bulletin.
239 *Amercoat Corp.

Coatings, Protective.....Phenoline 300 protects concrete . . . under severe corrosive conditions. Highly resistant to acids, alkalies, solvents. New Bulletin, sample of troweled Phenoline & corrosion data.
450 *Carboline Co.

Fabrication, Process Equipment.....Designed and built around the use of Haveg—basic construction material that resists corrosion. Includes size and chemical resistance charts in 64 p. illustrated Bulletin F-6.
21 *Haveg Corp.

Fabrication, Stainless Steel.....Offers quality workmanship, economical fabrication to the most exacting specifications . . . in large or small quantities. "Sheet and Plate Fabrication" upon request.
442 *Kirk & Blum Mfg. Co.

Fabrication, Steel.....Fully illustrated brochure furnishes detailed information about the company, the products they make, the manner in which they are organized, the facilities & equipment they have. 20 p.
454B Wm. Bros Boiler & Mfg.

Insulation, Cellular Glass.....Will give you the maintenance-free insulating performance you need for your piping, tanks, spheres and other industrial equipment. Request descriptive literature.
380 *Pittsburgh Corning Corp.

Insulation, Glass Fiber.....Versatile and efficient Ultralite features numerous advantages as insulation for all types of large heated equipment. Request "How-To-Do-It" details and specifications.
375 *Gustin-Bacon Mfg. Co.

Insulation, Industrial.....No matter where your insulation job may be—Armstrong can give you efficient, well-integrated, on-the-job service from original specs to final installation. Illustrated, 32 p.
69 *Armstrong Cork Co.

Insulation, Pipe.....Amosite...the South African asbestos with long, strong, resilient fibers gives Unibestos pipe insulation greater strength and superior insulating ability. Information in Bulletin No. 109C.
88 *Union Asbestos & Rubber Co.

Insulation, Pipe & Block.....New universal pipe & block insulation for all temperatures from 100° to 1600°F. Illustrated Folder shows specifications, installation details, and facts on Alltemp insulation.
39 *Philip Carey Mfg. Co.

Laminates, Resin-Bonded.....Pla-Tank resin-bonded laminate products for chemical-resistant service in metal finishing & chemical process industries. Data Sheets cover tanks, pipe, ducts, hoods, stacks, etc.
R459 *Chemical Corp.

* See explanation on p. 446

Building up files?

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Linings.....Describes Resilon 44 . . . a new concept—economy—convenience in corrosion-proof linings. Provides all the information on product including a table of chemical resistances. Bulletin RL-510.
102 *U. S. Stoneware Co.

Foil, Aluminum.....Illustrated, 52 p. includes sections on: physical, chemical & mechanical properties; general quality characteristics; foil converting operations; aluminum foil in packaging; etc. Form AD-305.
455A Aluminum Co. of America

Plastics.....Describes plastic properties and uses of Hercocel W, a new Hercules plastic based on cellulose. Hercocel W qualifies as a molding powder for *many* thermoplastic applications. Data Sheet 3-55.
76a *Hercules Powder Co.

Plastics.....“Packaging with Plastics” offers case histories of successful packaging applications, technical data on basic resins & new & unusual ideas on use of Bakelite plastics in the packaging field.
455B Bakelite Co.

Platinum, Gold & Silver.....Company announces the availability upon request of a descriptive reference entitled, “Platinum, Gold and Silver for Science, Industry and the Arts.” Coded as Folder No. C-20.
438 *American Platinum Wks.

Refractories.....Carborundum has pioneered scores of super refractories with a wide variety of properities to meet your most demanding requirements. For complete details, request Refractories Booklet.
281 *Carborundum Co.

Rubber, Chemical ..... “Facts About Hypalon” begins a new publication for maintenance, operating & design engineers which company will issue periodically. First issue details outstanding attributes of Hypalon.
455C E. I. du Pont de Nemours.

Steels, Specialty ..... New 32 p. illustrated guide to specialty steels made available to all steel users. Defines distinctive characteristics of a broad range of special purpose steels in terms of end use. 36 p.
455D Carpenter Steel Co.

Steels, Stainless.....Covers superior stainless steel sheets, strip, bars, plates, wire, forgings, etc. Data in informative 44 p. booklet, “Making the Most of Stainless Steels in the stailess, tool & electrical steels &
293 *Crucible Steel Co. of America

Steels, Stainless.....Offers “Special Steels for Industry”—16 p. of data on proper selection & application of principal AL special alloy products; stainless, tool & electrical steels & sintered carbides.
15 *Allegheny Ludlum Steel Corp.

Surfacing, Floor.....Newest advancement in continuous search for better corrosion-proof materials — offers greater protection than conventional acid-proof floor materials. Trial sample of Corocrete on request.
448 *Ceilcote Co.

Titanium.....Shows resistance to chloride solutions and retains useful strength up to 800-1000F. Other advantages and data on application and fabrication of titanium alloys in descriptive Rem-Cru Review.
378 *Rem-Cru Titanium.

* See explanation on p. 446

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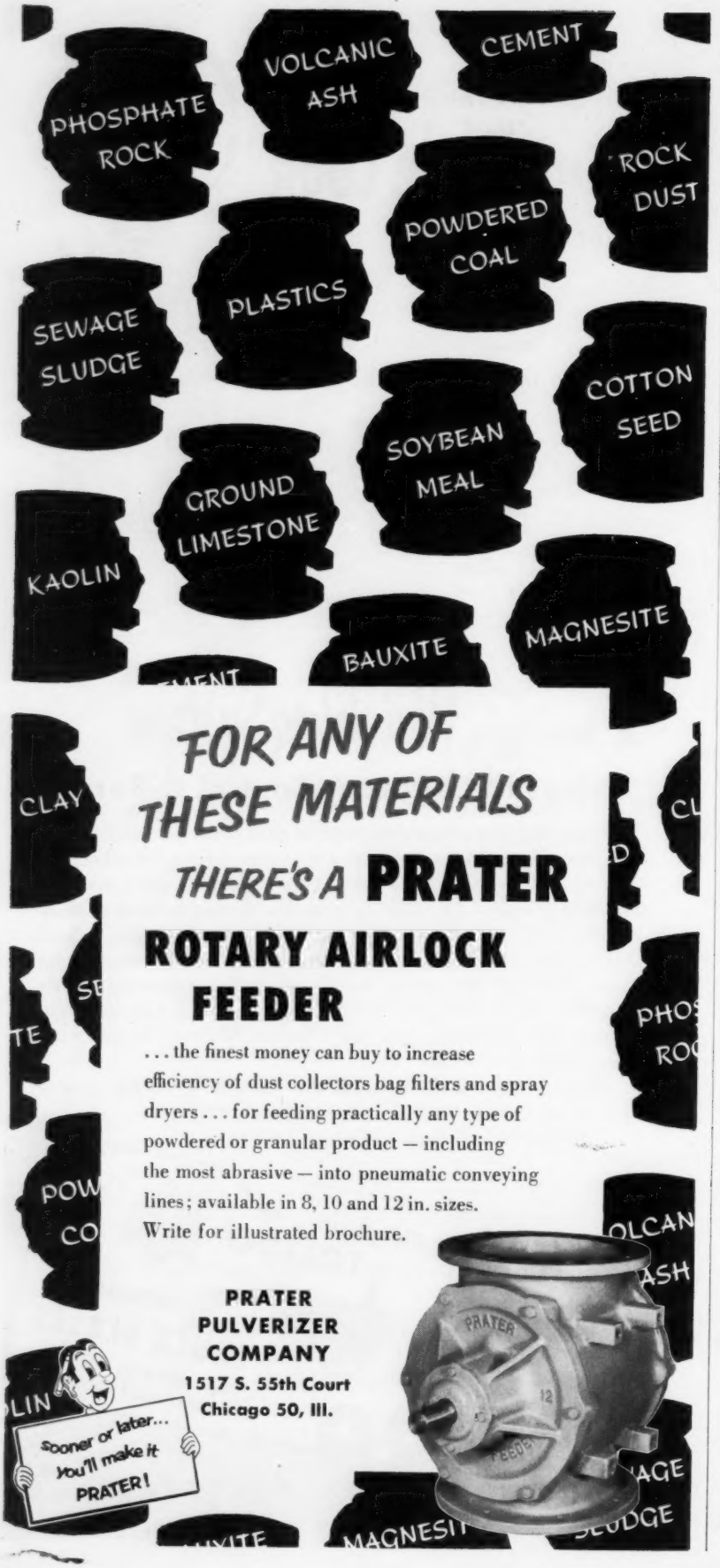
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LITERATURE . . .

Zinc.....Illustrated 32 p reference describes how zinc controls corrosion, lengthens life of steel products & reduces cost. Includes drawings, charts, photos, characteristics, building applications, etc.
456A American Zinc Institute.

Electrical & Mechanical

Capacitors.....Improve voltage regulation, boost plant circuit capacity, release transformer capacity & make it possible to get lower power rates thru power factor improvement. Booklets B-3966, DB 49-110-1.
376 *Westinghouse Elec. Corp.

Conductors, Bus.....There's an Alcoa aluminum bus conductor engineered to fit every bus application. For details, request your copy of "Service Records of Alcoa Aluminum Bus Conductor Installations."
56 *Aluminum Co. of America.

Drives ..... Describes the Cleveland Speed Variator—a simple, compact drive that provides infinitely variable output speed over a range up to 9:1 from a constant speed power source. Illustrated Bulletin K-200.
456B Cleveland Worm & Gear Co.

Drives, Variable Speed ..... Announces an all-new infinitely variable speed transmission designed to provide extreme accuracy of speed adjustment above and below the input speed. Bulletin Nos. 519 and 900.
456C Graham Transmissions.

Gaskets, Teflon.....The ideal seal for many process applications is a Flexitallic gasket with teflon trapped between edges of stainless steel. For complete data request folder, "Teflon in Flexitallic Gaskets."
326 *Flexitallic Gasket Co.

Machinery Parts, Alloy.....Illustrated, 28 p. describes machinery parts made of Haynes alloys that have been used under difficult service conditions to assure long, satisfactory machine operation. Book F-7158-A.
456D Haynes Stellite Co.

Motor Starter-Circuit Breakers.....Design, construction & performance of circuit breaker & motor starter Unilets give maximum safety & unparalleled ease of wiring, installation, maintenance. Bulletin BH.
313 *Appleton Elec. Co.

Motors.....Announces new line of general-purpose ball bearings polyphase motors in rerated NEMA frame sizes 182 thru 326. Suitable for indoor or outdoor use. Describes construction features in Bulletin No. MU-202.
82 *Wagner Elec. Corp.

Motors.....Company furnishes descriptive information on new Reliance motors and Metermatic . . . the "Automatic Grease Monkey." Find out how to eliminate burned out bearings. Bulletin No. A-2406.
387 *Reliance Elec. & Engrg. Co.

Motors.....Here is extra motor value—double-shielded bearing . . . large grease reservoirs...bolted-on bearing cap . . . labyrinth seals. For complete details on bearing design, request Bulletin 51B7225.
53 *Allis-Chalmers Mfg. Co.

Motors, Pump.....Describes company's latest line of vertical hollow shaft pump motors . . . designed and built for exacting demands of deep-well vertical turbine pumping. Includes design and construction features.
456E ACEC Elec. Corp.

Packings & Gaskets.....J-M Chempac-Interlocked packing combines both teflon and asbestos protection...resists virtually all chemicals. Descriptive reference furnishes complete data. Folder PK-80A.
372 *Johns-Manville.

* See explanation on p. 446

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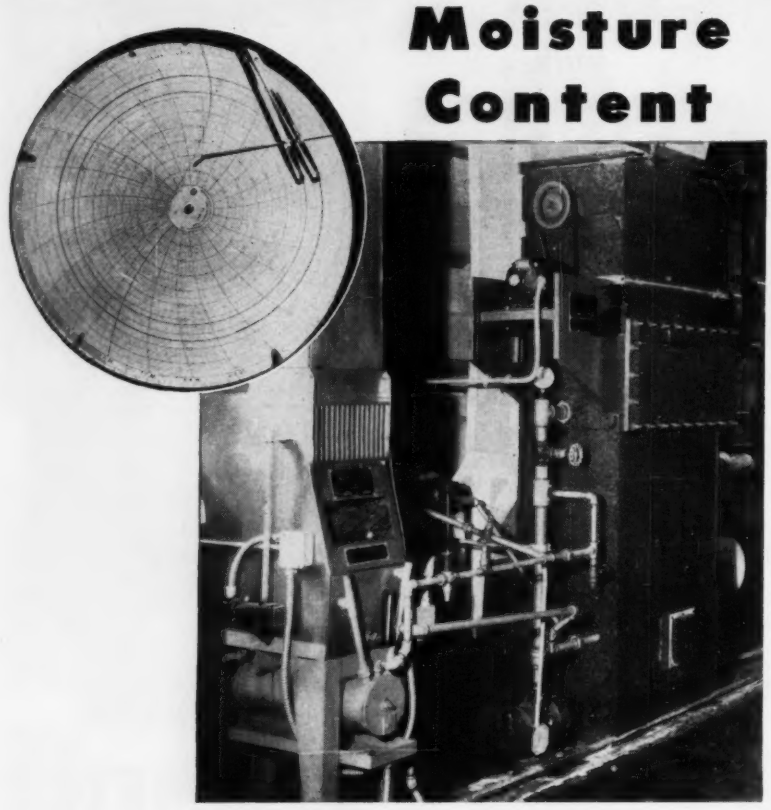

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LITERATURE . . .

Packings, Teflon.....Chemlon Yarn Style C-30 extra tough packing provides valuable advantages. It can be used to handle the most destructive acids, alkalis or solvents. For details, request Bulletin No. P-321.
331 *Crane Packing Co.

Packings, Tower.....Illustrated Folder describes Tellerette . . . a new polyethylene tower packing based on the principle of interstitial hold up. Feature increased efficiency & capacity, lighter weight, etc.
458A Harshaw Chem. Co.

Power Transmission, Mechanical..... Offers an illustrated 60 p. Engrg. Bulletin—for the instruction of Standard's representatives in the correct selection & application of petroleum products. Bulletin No. MP-212.
458B Standard Oil Co.

Pulleys, Variable Speed.....Product advantages, operating principles, installation procedures and specifications of the new Hi-Ratio variable speed pulleys are listed in a new, fully illustrated Brochure.
458C Equipment Engrg. Co.

Reducers, Speed.....Feature all advantages of shaft-mounting . . . all proven performance & economy features of Dodge Torque-Arm speed reducers—available for your big jobs. Bulletin offers details.
17 *Dodge Mfg. Corp.

Reducers, Speed.....40 p. covers "Line-O-Power" speed reducers with capacities ranging from fractional hp to 150 hp. Includes complete engineering data & specifications for all models. Engrg. Manual LP 3.
458D Foote Bros. Gear & Mach.

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TL457 *Babbitt Steam Specialty Co.

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458E Garlock Packing Co.

Seals, Mechanical.....Combining chemically impervious teflon with a balanced bellows design—Chemiseal external mechanical seals last longer & give unsurpassed performance. Details in Bulletin No. MS-954.
342 *U. S. Gasket Co.

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458F Sealol Corp.

Seals, Mechanical.....For meeting severe sealing conditions. Pressures from 50 psi to 1000 psi . . . temperatures from minus 80°F to 450°F. For data on applications, request Dura Seal Catalog 455-CE.
BL451 *Durametallic Corp.

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295 *Superior Elec. Co.

Transmission, Hydraulic, Variable Speed .....Features: infinitely variable speeds—up to 1500 rpm without gearing; constant or variable torque & hp; smooth braking & reversing; etc. Data in Catalog Section T-100.
460A Gerotor May Corp.

* See explanation on p. 446

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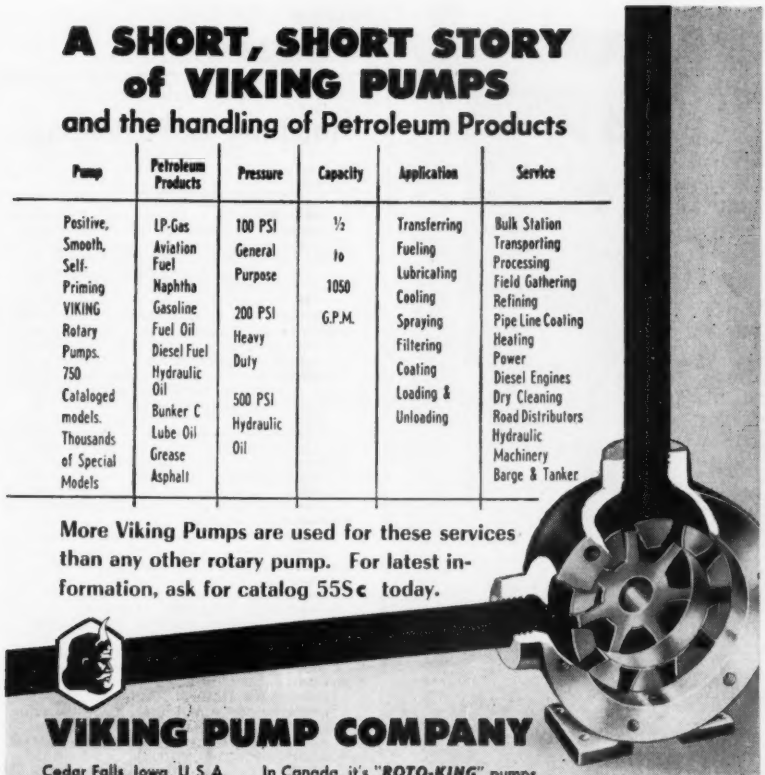

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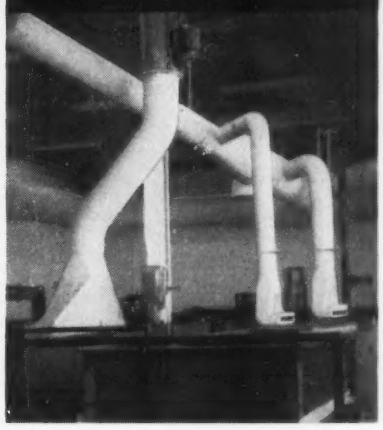

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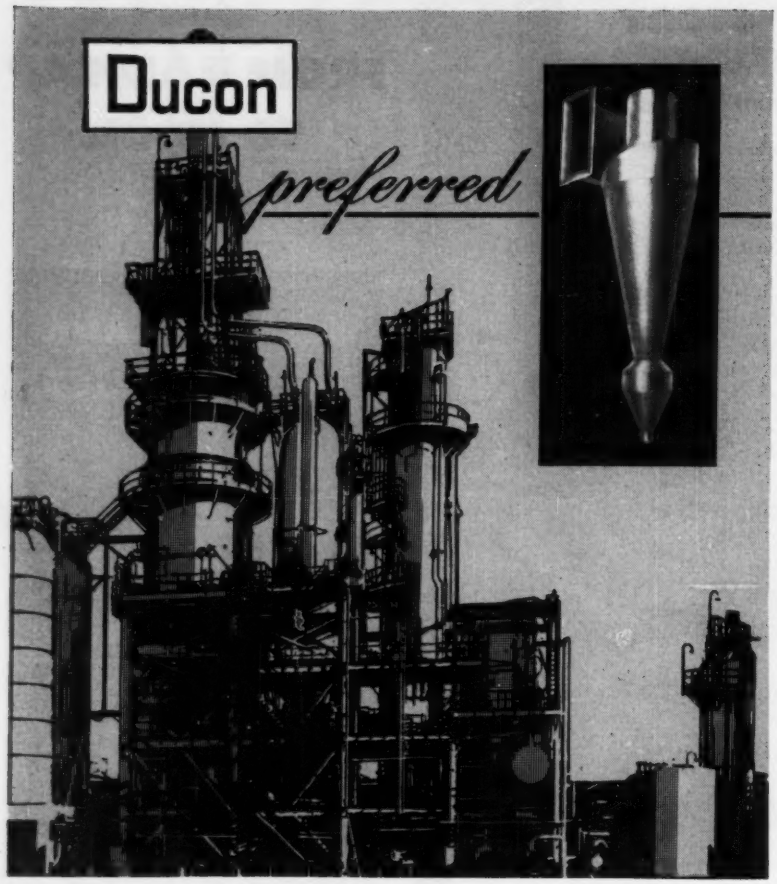

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Handling & Packaging

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460B Hemco Mfg.

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460C Diamond Alkali Co.

Chlorine Handling.....48 p. Handbook gives basic data covering safe storage, handling & use of chlorine. Subjects discussed: history & growth of chlorine industry; characteristics of chlorine; containers; etc.
460D Diamond Alkali Co.

Conveyor-Elevator Systems.....If you have the problem of moving anything from coal to cornstarch—without dust or product contamination—Redlers are an economical answer. Full details in Catalog No. 140.
24 *Stephens-Adamson Mfg. Co.

Conveyors.....New 16 p. catalog covers the entire line of Rapistan conveying equipment. Includes specifications and general data on each type of conveyor and shows actual applications of each unit.
460E Rapids-Standard Co.

Conveyors, Natural-Frequency.....Work on unique, patented vibrating principle which permits them to handle many materials too tough for most screw, belt, apron, vibrating, etc. conveyors. Bulletin No. 111.
62 *Carrier Conveyor Corp.

Conveyors, Pan Type.....New booklet includes concise and factual descriptions plus photos, drawings, drive data charts, methods of operation, advantages of construction, etc. Request Bulletin No. 3255.
460F Simplicity Engrg. Co.

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460G Raymond Corp.

Feeders & Crushers.....McLanahan reciprocating plate feeder & Rockmaster crusher for most economical feeding & crushing of large tonnages of rock, ore, limestone, etc. Bulletins RM-505 & FRE-4812.
345a *McLanahan & Stone Corp.

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456 *Prater Pulverizer Co.

Idlers, Suspension.....Covers neoprene belt conveyor idler of cable suspension type which resists most chemicals, has excellent resistance to abrasion, does not deteriorate in oil, etc. Bulletin No. LD-103B.
8 *Joy Mfg. Co.

Magnets, Hopper.....Built in any width desired, magnets efficiently remove tramp iron which causes machinery damage, fires, and product contamination. Ideal for surge-fed application. Bulletin B-204.
71a *Eriez Mfg. Co.

Material Handling Methods.....“Methods & Ideas” illustrates 48 manhour & space-saving handling operations, & shows various types of Barrett material handling equipment at work. Request Bulletin No. 552.
461A Barrett-Cravens Co.

* See explanation on p. 446

Materials Handling.....When time is important in handling dry materials in bulk . . . rely on Fuller systems (Fuller-Kinyon Airveyor, Airslide, Fuller-Fluxo). Data in "How To Pull Dollars Out of Thin Air."
153 *Fuller Co.

Overloaders.....Gives full description of Merton overloader. Well-illustrated & in two colors, brochure includes application suggestions, performance reports, optional equipment & specifications. Available on request.
461B Seaboard Equipment Co.

Packaging & Carloading.....Offers a 44 p. guide of usable facts to help you lower freight bills, end pilferage, reduce loss and damage claims, reduce container costs and speed packaging and shipping.
461C Signode Steel Strapping Co.

Panels, Pulsating.....Automation starts with PneuBin. It will solve your flow stoppage problems and reduce your operating expense. Request informative product literature and a "Flow Stoppage Report."
358 * Gerotor May Corp.

Separators, Magnetic.....Presents 16 p. fully illustrated reference covering line of non-electric permanent magnetic separators for removal of tramp iron. Includes data on Magnalarm. Request Catalog 17.
71b *Eriez Mfg. Co.

Vibrating Equipment.....Presents 232 p. fully illustrated catalog—a complete and concise reference book covering electric and mechanical vibrating equipment and magnetic separators. Request Catalog No. 870.
366 *Jeffrey Mfg. Co.

Heating & Cooling

Air Conditioning.....Exact control of moisture content . . . to improve your product or protect your materials or for processes or tests. For complete information, request descriptive Bulletins 112 & 121.
458 *Niagara Blower Co.

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231 *Cleaver-Brooks Co.

Boilers, Packaged.....Bros packaged boilers fulfill all steam requirements in the medium pressure range. Offer high steam generating efficiencies with economy of installation & low maintenance costs. Form WT-7.
461D Wm. Bros Boiler & Mfg. Co.

Burners.....Announces a new line of U.L. approved power pressure burners. Available in straight oil, straight gas, & combination gas-oil, burners incorporate latest developments. Details in Bulletin No. 655.
461E Ray Oil Burner Co.

Coolers, Cascade.....Designed for cooling corrosive liquids and gases. Low initial cost and maintenance, radiused returns for low pressure drop as well as redwood waterguide strips. Request Catalog No. S-6820.
235f *National Carbon Co.

Generating Equipment, Steam.....Company specializes in design & manufacture of steam generating equipment. Line of watertube boilers give top performance because of balanced design features. Form No. WT-4.
461F Wm. Bros. Boiler & Mfg. Co.

Generators, Steam.....Vogt steam generators are available in bent tube types and straight tube forged sectional header types for solid, liquid or gaseous fuels. Request descriptive product Bulletins.
168 *Henry Vogt Mach. Co.

* See explanation on p. 446

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LITERATURE . . .

Heat, Dielectric ..... Illustrated, 12 p. literature reference features sections on: Dielectric Heat—What Is It?; Is Dielectric Heat Efficient?; Uses of Dielectric Heat (in plastics, rubber, woodworking, etc.).
462A Resdel Engrg. Corp.

Heat Exchangers.....Describes how equipment offers: chemical resistance to practically all corrosive fluids; resistance to severe thermal shock; high heat-transfer rates; low maintenance; etc. Catalog S-6740.
235d *National Carbon Co.

Heat Exchangers.....B&G shell and tube heat exchangers give you more value. Basically efficient in design, these units are offered with straight and U-bend tubing. For full details, request Catalog DM-1150.
37 *Bell & Gossett Co.

Heat Exchangers ..... Describes Type "SSF" stainless steel heat exchangers for heating or cooling liquids & gases as used in industries where elements of corrosion to alloys are encountered. Catalog No. 1155.
462B Young Radiator Co.

Heat Exchangers.....Covers complete line of Karbate brand impervious graphite shell & tube heat exchangers. Engineered for maximum corrosion resistance & minimum maintenance. Request Catalog Section S-6840.
235e *National Carbon Co.

Heat Transfer Apparatus.....Now . . . you can recover heat from gases at extreme temperatures. Bulletin covers design, construction & applications of G-R High-Temperature K-Fin Heat Transfer Surface.
394 *Griscom-Russell Co.

Heat Transfer Apparatus.....Versatile & efficient dryer-cooler does four big jobs—crystallizes . . . dries . . . anneals . . . cools. Describes Allis-Chalmers heat transfer equipment in Bulletin No. 07B6368.
99 *Allis-Chalmers Mfg. Co.

Heat Transfer Apparatus ..... Highlights representative products in company's line of heat transfer equipment. Includes: oil heaters & coolers, strainers, evaporators, heat exchangers, etc. Condensed Bulletin HT-1.
462C Schutte & Koerting Co.

Heaters, Deaerating.....Describes the design, operation & application of heater. Photos & cross-sectional diagrams illustrate construction & versatile manner in which it can be installed. Bulletin No. WC-118.
462D Graver Water Conditioning Co.

Heaters, Gradiation.....Makes available informative bulletin, "Gradiation Heating for Petroleum & Chemical Processing" & article reprint, "Try the Gradiation Heater for Economical Ethylene Production."
20 *Selas Corp. of America.

Heaters, Unit.....Discover the many valuable features of the Unitherm unit heater . . . available for steam or hot water operation, floor or ceiling installation, in a wide size range. Catalog No. 1115.
54 *Clarage Fan Co.

Heaters, Unit.....Grid unit heaters feature trouble-free heating service in the major chemical plants for over 25 years—no maintenance or repairs. Get the full story in booklet, "Corrosion in Unit Heaters."
68 *D. J. Murray Mfg. Co.

Heating Systems, Dowtherm.....Furnishes descriptive information on Dowtherm heating systems for processes requiring precision control of high constant temperatures at low pressures, in Bulletin ID-54-5.
125 *Foster Wheeler Corp.

Heating Units, Electric.....Feature many cost saving advantages: low installation cost; clean electric heat; long heater life; continuous production; etc. Complete information offered in Catalog No. 50.
516-7 *Edwin L. Wiegand Co.

* See explanation on p. 446

Heating Units, Immersion.....Your fuel dollar buys more effective heat transfer with "Surface" immersion heating than with other methods of heating liquids and salts. Details contained in Bulletin H55-4.
R353 *Surface Combustion Corp.

Humidifiers.....New booklet describes humidifiers for "small" rooms . . . shows how plants can cure small room humidification problems by a single steam humidifier installation. Request illustrated Bulletin 501.
463A Armstrong Mach. Wks.

Tandem Combustion Units, Oil-Gas..... You will realize higher profits from your heaters when National Airoil vertical or horizontal tandem units are specified. For full details, request Bulletin 498.
354 *National Airoil Burner Co.

Towers, Cooling.....New 20 p. booklet, "Test Your Tower," describes simple direct method by which purchaser of industrial cooling tower can assure himself that he will receive performance exactly as specified.
9 *Marley Co.

Traps, Steam.....Covers Thriftraps . . . a complete line of compact, versatile, high-capacity traps. Inverted bucket type traps feature economy—in initial cost & long, trouble-free service. Section No. 601.
463B Clark Mfg. Co.

Traps, Steam.....Company's product line features long trap life with infrequent maintenance. Makes available on request a 44 p. Steam Trap Book with practical information designed to give you better trapping.
386 *Armstrong Mach Wks.

Traps, Steam.....Illustrated literature describes Sarco's Type TD-50 Thermodynamic steam traps . . . for pressures 10-600 psi and temperatures to 950° F. Includes numerous features. Supplement No. 255-44.
463C Sarco Co.

Traps, Steam.....Larger valve orifice saves four ways; initial cost; upkeep expense; warm-up time; production time. Six types for every process, heat, power use. Complete information in Trap Catalog 953.
74 *W. H. Nicholson & Co.

Instruments & Controls

Analyzers, Oxygen.....The Unitized O_2 Analyzer can help to streamline O_2-dependent processes. For pertinent information concerning this O_2 monitor, request company's detailed Folder No. ND46-91(5).
243 *Leeds & Northrup Co.

Control, Reactor.....Taylor has pioneered in the development of control systems for chemical reactors. Data Sheet No. 9 covers in great detail recommended instrumentation for various types of reactors.
400 *Taylor Instrument Cos.

Control Systems, pH.....Designed for use in any pH process application—combine in a single package all components needed for single or multiple-channel pH process monitoring, recording & controlling. Bulletin 384.
463D Beckman Instruments.

Controls.....Describes wide range of Cash Standard pressure, hydraulic, temperature, process and combustion controls. Includes recommended applications, construction & operation features, etc. Bulletin S-730.
463E A. W. Cash Co.

Controls, Level.....Tektor level control indicates or controls level of fluids, powder, solids (conducting or nonconducting). Features low first cost . . . low operating cost. Request informative literature.
347a *Fielden Instrument Div.

* See explanation on p. 446

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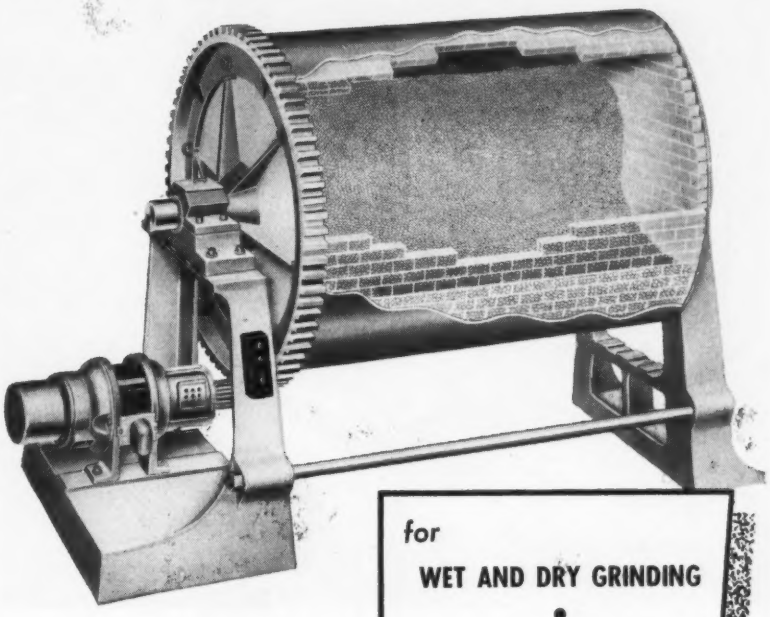

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LITERATURE . . .

Controls, Liquid Level.....Company widens its scope of liquid level measurement & control with the Fisher "Belmont Series" of capacitance type electronic liquid level controllers. Bulletin F-100.
259 *Fisher Governor Co.

Controls, Pressure.....Fireye 80B pressure controls are designed for many important industrial uses. They provide high & low limit control for steam, air & non-corrosive liquids & gases. Data in Bulletin CO-30.
464A Electronics Corp. of America.

Controls, Process.....Feature the utmost in centralized recording & control efficiency. Require minimum of panel space, yet offer unsurpassed operator convenience, visual accuracy, etc. Bulletin 13-18.
40-1 *Foxboro Co.

Controls, Safety ..... Manufacturer of boiler water level controls, relief valves related safety devices releases valuable bulletin, "Basic Safety Controls for Hot Water Space Heating Boilers," No. P-30.
464B McDonnell & Miller.

Fractometers, Vapor.....For analysis of multi-component mixtures of gases or volatile liquids. Brochure describes operation, components and uses for new instrument as well as giving complete specifications. 6 p.
464C Perkins-Elmer Corp.

Gages.....Announces new line of small-size, easy-to-read gages & receivers. Important features: 5 in. illuminated scales; independent interchangeable units; easily mounted; etc. Data in Bulletin V5.
34 *Republic Flow Meters Co.

Gages.....For pressure, vacuum or compound service. There are no gears or teeth to wear out. Cam wiping action keeps contact points clean & smooth. Provides complete information in Gage Catalog No. G-2.
344 *Helicoid Gage Div.

Gages, Tank.....New Series 1400 Petrometer remote reading liquid depth gages are designed for convenient, rapid installation, easy, trouble-free operation, & accurate indication. Details in Bulletin No. 6004.
464D Liquidepth Indicators.

Gages, Ultrasonic.....Offers a new illustrated reference on the "Vidigage" Ultrasonic resonance thickness gage. Included are operating principles, typical applications and features. Request Folder No. V-101.
464E Branson Instruments.

Indicators, Sight Flow.....Literature describes the new line of sight flow indicators . . . easily and inexpensively installed in any new or existing pipe line ½" to 2" N.P.T. Request Data Unit.
R351 *Jerguson Gage & Valve Co.

Instrumentation, Miniature.....Whenever you're planning graphic process control, plan to take advantage of the extra values built into the latest Tel-O-Set miniature instruments. New Bulletin No. 7202.
158-9 *Minneapolis-Honeywell

Measurement & Control, Low Level..... Solutions to problems of low-level measurement & control supplied by Weston Inductronic System—an entirely different method of d-c amplification. Bulletin B-36-B.
388 *Weston Elecl. Instrument.

Meters.....Describes the Alnor Velometer—a precision-built, self-contained, portable instrument which gives instant, accurate readings of air velocities anywhere. Full details in Bulletin No. 2448-G.
R457 *Illinois Testing Labs.

Meters, Feeders & Controls ..... Describes company's extremely varied line of equipment for metering, for chemical feeding and proportioning, and for controlling processes and operations. Bulletin No. B-I-F 5.
466A B-I-F Industries.

* See explanation on p. 446

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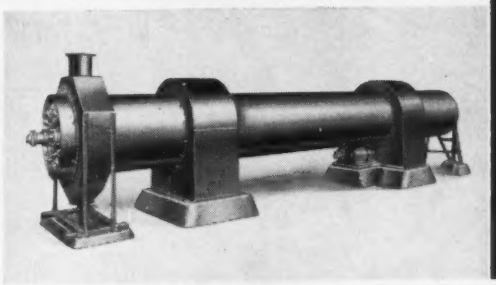

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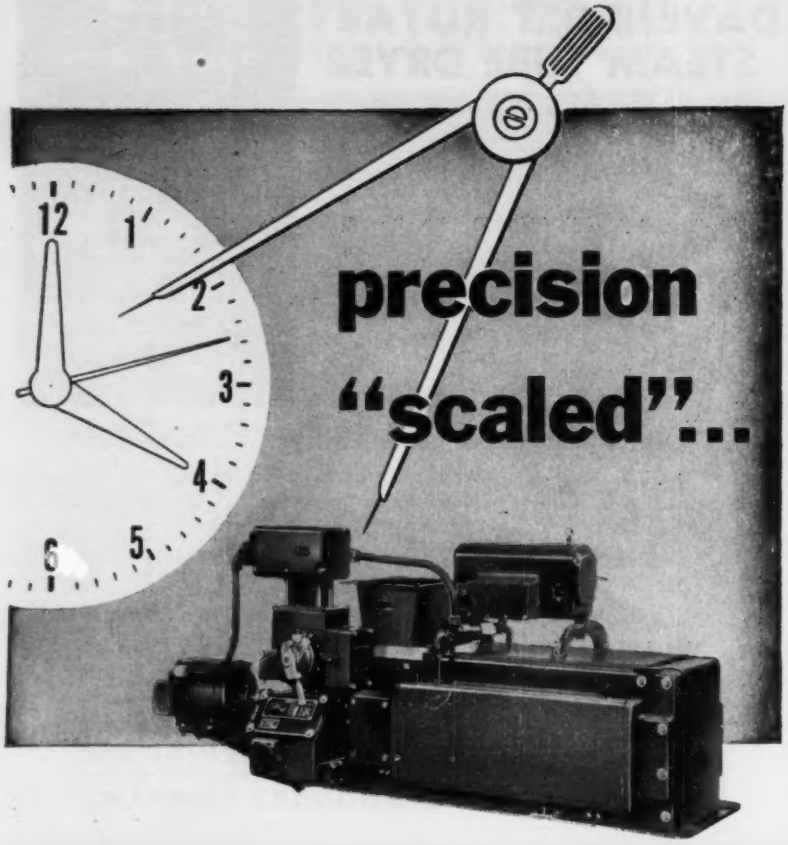

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Minute to minute accuracy in the feeding of dry materials — uniform delivery to reaction tanks, continuous blending, or batch mixing — is a requisite for maintaining uniformly high quality in final products, in modern chemical processing operations.

W & T Merchen Scale Feeders which weigh and feed in one operation ensure this exacting accuracy. Precision "scaled", durably constructed and simply controlled, the Feeder weighs all material and immediately compensates by weight for variations in density, moisture content, etc. Whether feeding ounces or pounds per hour, the pre-set rate of feed is continually and automatically maintained.

If you have a processing problem requiring uniform feeding of dry materials, accurately controlled by weight, communicate with Wallace & Tiernan. You'll receive prompt attention without obligation.

M-21

WALLACE & TIERNAN
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LITERATURE . . .

Recorders.....Offer valuable features: pre-calibrated plug-in receiver units; up to 4 pneumatic or electronic receivers—or 2 receivers & 2 integrators; etc. Product Spec. E12-5 & actual chart sample on request.
306 *Bailey Meter Co.

Pipe, Fittings, Valves

Couplings.....Kamlok's positive seal all along the line assures greater safety in handling all types of liquids. Valuable reference highlights in detail Kamlok's quick, tight seal. Bulletin No. F-10.
14 *OPW Corp.

Couplings.....Offers new quick-connect, quick-disconnect coupling, which can be used for high pressure as well as gravity flow & vacuum. Provides instant line shut-off when equipped with valves. Bulletin 250.
466B Snap-Tite, Inc.

Fittings.....Offers Klinger Master Catalog describing the complete range of products . . . compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic and silicone rubbers, etc.
271b *Klinger Corp. of America.

Fittings ..... Fully illustrated booklet describes Flodar Combination (self-flaring) fittings for hydraulic pressures. Standard sizes ¼" to 2" O. D. tubing. Details features & performance. Catalog BA 555.
466C Flodar Corp.

Fittings, Forged Steel.....Wherever strong, tough pipe joints are needed . . . Watson Stillman forged steel fittings provide a safety factor against costly piping failures. Details in Bulletin No. A3-50.
371a *Watson-Stillman Fittings.

Fittings, Stainless Steel.....Company announces the availability upon request of a complete stainless steel fitings catalog giving engineering drawings, dimensions and basic material data. Catalog No. 55F.
119d *Cooper Alloy Corp.

Fittings, Stainless Steel.....New stainless steel fittings will assure you of long, trouble-free service in tough piping applications . . . will reduce down-time and cut maintenance costs. Bulletin No. S-3-55.
371b *Watson-Stillman Fittings.

Hose, Plastic.....New illustrated Bulletin describes company line of plastic hose & hose assemblies, sheets & molded products. Lists physical & chemical properties of material, including permeability to gases.
466D Resistoflex Corp.

Nozzles, Spray.....Company makes available on request a completely detailed Catalog which provides valuable data on Spraco Nozzle line. Includes information on full cone, flat spray & hollow cone types.
BL353 *Spray Engrg. Co.

Nozzels, Spray.....Reach a new peak in spraying efficiency . . . with Yarway non-clog nozzles. Reference includes capacities, dimensions, application information, etc. Request Spray Nozzle Book No. N-617.
45 *Yarnall-Waring Co.

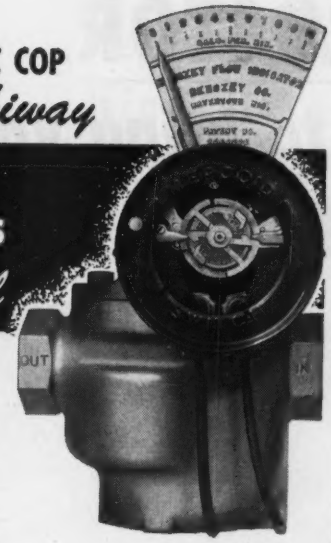
Pipe & Fittings.....For corrosion-resistant piping. Impervious graphite pipe & fittings readily installed, long lasting, easily maintained, unaffected by most corrosive fluids. Request Catalog No. S-7000.
235e *National Carbon Co.

Pipe & Fittings, Glass.....Glass Pipe & fittings for full-scale production operations. Strengthened by end-tempering & feature corrosion-resistance, non-contamination, etc. Catalogs EA-1 & EA-3 offer full data.
232-3a *Corning Glass Wks.

* See explanation on p. 446

A FULL TIME TRAFFIC COP
on your fluid hiway

HENSZEY FLOW METERS
with Alarm Control



RINGS A BELL—LIGHTS A LIGHT or ACTIVATES a MOTORIZED VALVE

There are only three moving parts in the HENSZEY FLOW METER — no breakdown due to complicated gears and mechanism. Goes right in the line — no additional supports. Indicates flow within 3% absolute accuracy, even with pulsating flow. Send for bulletin.

SOUND ALARM AT HIGH OR LOW FLOW!

Easy to set on face of switch — unaffected by dust, dirt or corrosion — no pitting or sticking.

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LIQUIDOMETER
Tank Gauge

- FOR GAUGING LIQUIDS OF ALL KINDS
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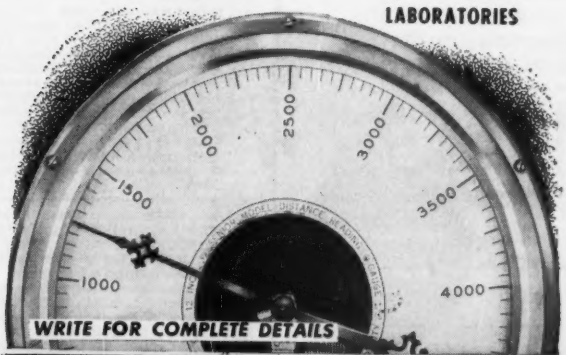
- APPROVED BY UNDERWRITERS' LABORATORIES



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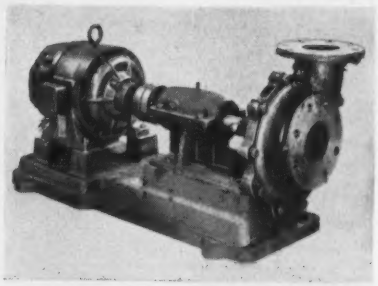
YOU CAN DEPEND ON
Frederick



SSV PUMPS

for most efficient, carefree service!

CHECK THESE FEATURES

- Single stage, single end suction—with enclosed or open impeller.
- 1" to 4" discharge openings; heads up to 220 feet; operating speed—1750 rpm.
- One piece impellers, secured to shaft by key and lock nut, or threaded, give long service.
- Flanged suction and discharge openings mean easier connecting and disconnecting of joints.
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- Extra large stuffing box, or mechanical seal—both provide minimum leakage.

Enclosed impeller types for chemicals, oils, juices, clear liquids, acids, etc. Open impeller types for slurries, brewery mash, food mash, white water, paper stock up to 2% consistency, etc. Constructed of metals to meet *your* requirements—cast iron, nickel, stainless steel, monel, etc. Send your requirements to our skilled staff for suggestions. Ask for free copy of Bulletin 107.

FREDERICK PUMPS

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FREDERICK *Est. 1890* MARYLAND

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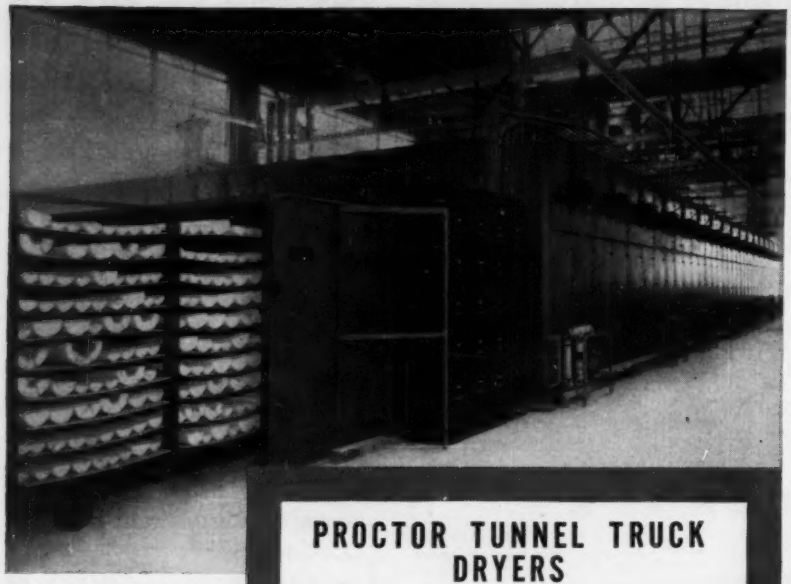

Proctor Tunnel Truck Dryer for molded insulation. Highly effective for handling materials not suitable for drying in a conveyor type dryer.

PROCTOR TUNNEL TRUCK DRYERS

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- Quicker Erection
- Improved Air Circulation
- Easily Expanded

Proctor Tunnel Truck Dryers have long been standard in the chemical and process industries for efficient, continuous drying of materials, which by their size, density, or composition require prolonged drying times or conditioning periods. Now an entirely new type of housing construction offers added advantages in terms of speed of erection and smoother, easier-to-clean interiors. Latest temperature, humidity, and air circulation controls assure flexibility of operation, while improvements in the air circulation system result in new uniformity of air distribution, and better drying.

Proctor engineers are backed by a record of more successful drying installations than any other company in the world . . . they will be glad to recommend equipment best suited to your needs.

Write for information bulletins on the following Proctor Drying Equipment

- Tray Dryers
- Truck Dryers
- Pre-forming Feeds
- Continuous Conveyor Systems
- Spray Dryers

Proctor

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Manufacturers of Industrial Drying Equipment and Textile Machinery • Philadelphia 20, Pa.

LITERATURE . . .

Pipe, Fittings & Valves, Tin-Lined..... Designed especially for distilled water distribution systems . . . combines chemical protection of pure tin with strength & durability of threaded pipe. Bulletin 134.
468A Barnstead Still & Sterilizer.

Pipe Installation, Glass.....Pipe is easy to install & low in installed cost compared with other corrosion-resistant materials. Available in 6 standard sizes from 1- to 6-inch. I.D. inclusive. Installation Manual PE-3.
232-3b *Corning Glass Wks.

Pipe, Laminated Teflon ..... Covers physical & chemical properties, advantages & specifications of Fluoroflex-T laminated pipe, manufactured from woven glass impregnated with teflon resin. Bulletin FTL-1.
468B Resistoflex Corp.

Pipe, Plastic.....Ace hard rubber—now more than a century old—long the finest corrosion-resistant pipe available. Widest variety of fittings of any rigid non-metallic pipe. Details in Bulletin No. CE-51.
335a *American Hard Rubber Co.

Pipe, Plastic.....Illustrated Folder describes a new thermosetting corrosion service pressure plastic pipe. Durable, light-weight, easy-to-handle & corrosion-resistant—suitable for wide range of applications.
468C Reflin Co.

Pipe, Plastic.....General-purpose moderately priced rubber-plastic pipe handles most common chemicals to 170°F . . . except few strong acids & organic solvents. Tough, odorless, tasteless. Bulletin No. 80.
334 *American Hard Rubber Co.

Unions, Stainless Steel.....Comprehensive illustrated literature on stainless steel unions specifically designed and constructed for top performance on all metering, measuring and flow control services.
BL449 *Clayton Mark & Co.

Valves, Air Release.....Describes Simplex air release valves . . . for water, sewage & industrial use. Includes data on essential requirements, methods of installation, operation, uses, wts., etc. Bulletin 1204.
468D Simplex Valve & Meter Co.

Valves, Diaphragm.....From antibiotics to the toughest acids, alkalis and salts, there is a combination of Hills-McCanna body and diaphragm materials that will best suit your needs. Request Valve Catalog.
441 *Hills-McCanna Co.

Valves, Diaphragm Control.....Throughout the entire range of valve travel—positioning is accurate & undistorted—control increments are finer with minimized positioning error. Full details in Bulletin CV-53.
97 *Kieley & Mueller

Valves, Drain.....Offers descriptive information on line of Strahman ram type valves . . . the only drain valves that cannot clog up. Made in any cast metal to meet your requirements. Request complete Catalog.
BR357 *Strahman Valves

Valves, Forged & Cast Steel.....Product line features the utmost in quality and performance. Condensed Catalog provides complete information on all Rockwell-built Edward forged and cast steel valves.
338b *Edward Valves

Valves, Gate.....Offers data on sturdy, small forged steel gate valves. Superhardened gate and seats assure tight closure, smooth operation and low maintenance. Complete information offered in Catalog No. 10.
304 *Chapman Valve Mfg. Co.

Valves, Lubricated Plug.....28 p. catalog shows straightway, 3-way, 4-way, & multiple port lubricated plug valves for 250 lbs. oil-water-gas & 150 lbs. steam working pressure. Reference Book 39—Section 5.
469A Homestead Valve Mfg. Co.

* See explanation on p. 446

Valves, Manual Reset.....Fireye Series 81G manual reset valves for use in automatically shutting off flow of fuel in oil and gas burners in cases of faulty operation, fully described in illustrated Bulletin CV-31.
469B Electronics Corp. of Amer.

Valves, Monel & Nickel.....New reference discusses the corrosion-resistant properties of Monel and nickel, listing specific applications for which each is suited. Request fully illustrated Bulletin No. 9.
469C Alloy Steel Products Co.

Valves, Plug.....Company's line of non-lubricated steel plug valves features dependable performance at a wide range of temperatures and pressures. For complete details, request informative Wedgeplug Catalog 54-1-W.
299 *Wedgeplug Valve Co.

Valves, Porcelain.....Company makes available detailed literature covering the features and advantages of porcelain valves. Bulletin includes complete description, characteristics and specifications of product line.
315 *Lapp Insulator Co.

Valves, Stainless Steel.....Announces availability of a 68 p. simplified stainless steel valve catalog which includes engineering drawings, wts., size ranges, dimensions & basic material data. Catalog No. 55D.
119c *Cooper Alloy Corp.

Process Equipment

Absorbers.....For absorption of hydrogen chloride and other gases. Produce as much as 20 tons per day 22° Baume acid. Pneumatic automatic control. Complete information offered in Catalog No. S-7460.
235g *National Carbon Co.

Agitating Equipment.....Fully illustrated, 50 p. covers: Model WT Agitator Drive; Model T & TA Agitator Drives; Model TB & TAB Agitator Drives; Model No. 3 Agitator Drive; Flomix; etc. Catalog No. 530.
318a *New England Tank & Tower.

Blast Cleaning Equipment.....New 8 p. reference describes Hydro-Finish liquid blast cleaning equipment. Contains photographs, detailed drawings, dimensions, sizes and features of all models. Bulletin 1403.
469D Pangborn Corp.

Centrifugals, Center-Slung.....When your process calls for liquid-solids separation by centrifugal force . . . you can do it more economically with the new Tolhurst Center-Slung centrifugal. Descriptive Catalog.
219 *American Mach. & Metals.

Centrifuges.....The Sharples Laboratory Super-Centrifuge develops the highest centrifugal force commercially available. For complete information on operation and applications, request Bulletin No. 1269.
129 *Sharples Corp.

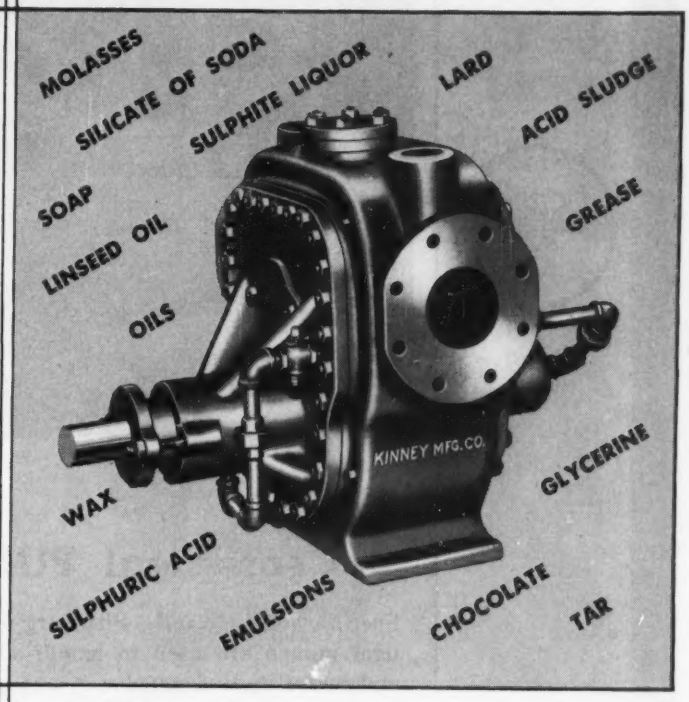
Collectors, Multi-Wash.....For the efficient removal of air-borne contamination (dust, fumes, vapors, acid gases and odors) and recovery of product thru multiple washing action. Details in Bulletin No. 610.
TL451 *Claude B. Schneible Co.

Columns, Contact ..... Company announces the development of a continuous contact column in which solids settle down through an upward flow of liquid. Details contained in a new leaflet, No. 07R8289.
469E Allis-Chalmers Mfg. Co.

Crushers, Toothed Roll.....New booklet describes crusher line—tells how to get rid of obsolete manual crushing methods on miscellaneous chemicals ranging from wax-like material to very hard substances.
R451 *Franklin P. Miller & Son.

* See explanation on p. 446

Here's the Low Cost way to Pump High Viscosity Materials . . .



Install Kinney Model SD Rotating Plunger Pumps. Rugged, simple in construction . . . without valves, blades, springs, or vanes . . . the Kinney SD gives you maintenance-free performance, even while pumping the most difficult viscous materials.

The Kinney SD Pump acts as a meter, too. Due to its unusually high volumetric efficiency, this pump is often used to meter and proportion fixed amounts of viscous materials and components.

Kinney SD Pumps are available in capacities ranging from 2 GPM to 3,000 GPM . . . steam jacketed in most sizes.

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Please send Bulletin L51 describing the complete line of Kinney Liquid Pumps.

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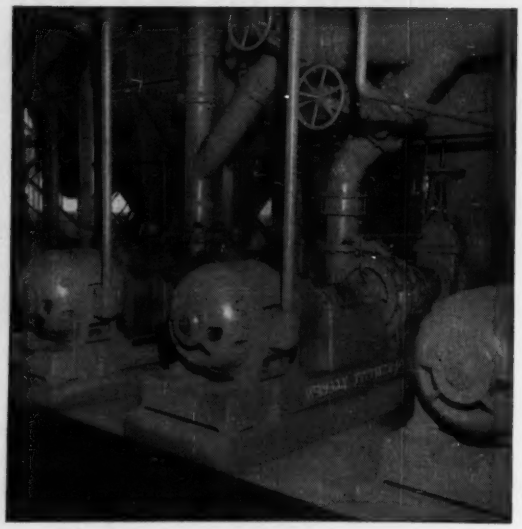

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Special Built McNally Pittsburg centrifugal pumps are used to handle abrasive and corrosive sludges, slimes, and slurrys. They give maximum pumping service for years.

In these slurry pumps, the volute, impeller, wearing plate and suction nozzle are cast of McNally specification NiHard. The pumps are of open impeller, single stage type. They are direct connected, or v-belt driven, depending on the type of service and installation requirements.

SPECIAL DESIGN

McNally Pittsburg designs special centrifugal pumps to your requirements; or builds special pumps to your design. For Information Write to Either Plant.

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LITERATURE . . .

Cyclones, Liquid.....For all operations involving thickening, de-watering, classifying, densifying, clarifying, desludging & desliming of liquid-solid solutions. Illustrated Bulletin offers complete information.
470A Centrifugal & Mech. Industries.

Demineralizers.....Available in two-bed, three-bed, four-bed and mixed bed units, of manual and automatic designs, and for any capacity. For complete information, request company's Bulletin No. 5800-B.
33 *Cochrane Corp.

Discs, Filter ..... Illustrated bulletin, "Glass Fiber Filter Discs," describes filter discs and gives the shapes, fiber diameters, disc diameters, disc thicknesses and disc densities available. 4 p. Literature.
470B Friedrich & Dimmock.

Dryers.....Lectro-dryers can dry air & gases in volume to dewpoints below —100°F—can drop relative humidity lower than 10%. Booklet describes machines & how various industries use them to gain efficiency.
84 *Pittsburgh Lectrodryer Corp.

Dryers, Rotary.....Deliver top production, exacting performance, greater profits. Tells how Standard-Hersey has aided manufacturers throughout the world in solving their dryer problems in illustrated, 12 p.
TR357 *Standard Steel Corp.

Dryers, Rotary Vacuum.....Company announces the availability of literature on their vacuum drying equipment (Catalog No. 720) and a new reference covering Stokes Laboratory facilities (Bulletin No. 640).
166 *F. J. Stokes Mach. Co.

Dryers, Vacuum.....Faster, uniform heat transfer, plus rapid vapor removal . . . means today's best in vacuum drying with the Patterson Conaform. For complete product data, request new detailed Bulletin.
131 *Patterson Foundry & Mach.

Dust Collectors.....Describes National's Hydro-Filter—the triple-action dust collector. Covers operating principle, outstanding features, construction & design, dimension & application data, etc. Bulletin 55.
470C National Dust Collector Corp.

Dust Collectors.....In almost every type of industry . . . users have found high efficiency, simplicity & economy of Dustube collectors a difficult combination to equal for top performance. Bulletin No. 372.
152 *American Wheelabrator.

Dust Collectors.....Model D Aeroturn dust collector features high efficiency, compactness, economy. Describes what it is, how it works, its size, how it's made, the many advantages, etc. in Bulletin 303.
470D Turner & Haws Engrg. Co.

Dust Control.....Pangborn engineers help solve your dust problems—line of wet or dry dust collectors can save time, trouble & money. See how varied industries are benefited in "Out of the Realm of Dust."
356 *Pangborn Corp.

Dust Filters.....The Day "AC" dust filter offers many features: high filtering efficiency; automatic continuous operation with minimum filter; higher filtering rates; great economy; etc. Data in Bulletin 528-R.
470E Day Co.

Ejectors, Steam Jet.....The steam jet ejector is the ultimate in mechanical simplicity, consisting of only 3 basic parts—a steam nozzle, a suction chamber & a venturi-shaped diffuser. Bulletin 9013A.
241 *Ingersoll-Rand Co.

Evaporators.....Complete Swenson Catalogue contains full information on long-tube vertical evaporator, spray dryers, crystallizers, forced circulation evaporators & recovery equipment for pulp mills.
6-7 *Swenson Evaporator Co.

* See explanation on p. 446

Extruding Machines, Screw-Type ..... Fully illustrated, 32 p. describes Farrel-Birmingham screw-type extruding machines — plasticators, pelletizers, extruders, strainers, strainer-extruders, etc. Bulletin 195.
471A Farrel-Birmingham Co.

Filters, Pressure Leaf.....For flow rates two to five times greater than cloth covered presses; positive removal of all suspended solids to desired degree of clarity; etc. Find details in Catalog No. NC-1-53.
217 *Niagara Filters Div.

Filters, Sand.....Automatic backwash sand filter is a departure from standard filtration equipment — it backwashes its filter bed automatically without interrupting normal filtration. Bulletin 46-A-11.
348 *Hardinge Co.

Filters, Tank.....Use Sparkler MCR retractable tank filters and collect cash dividends in labor savings and operating economies. Descriptive product literature covers features and operation.
93 *Sparkler Mfg. Co.

High-Pressure Equipment.....Equipment described in new 100 p. catalog embraces pilot plants, reaction vessels, fittings, valves, tubing, pumps, compressors, instruments, etc. Request Catalog 406-C.
TL353 *American Instrument Co.

Kilns, Rotary.....Efficient thermo-processing of products. Used in the production of lime, bauxite, cement, sodium silicate, alumina, etc. Complete data on design features offered in illustrated Bulletin 1115.
28a *Traylor Engrg. & Mfg. Co.

Mills, Ball & Pebble.....Outstanding in the field of fine grinding, mixing and processing. Built of all steel welded construction, they feature great strength and ruggedness. 20 p. illustrated Catalog No. 100.
297a *International Engrg.

Mills, Ball & Pebble.....Valuable references give complete details on the Abbé Engineering series of mills for every range of work from small batch jobs to full scale plant production. Catalogs Nos. 73 & 77.
463 *Abbé Engrg. Co.

Mills Vertical.....Company is presenting compact, high-speed pulverizers which offer an economical means of making super-fine materials to meet today's high specifications. Full details available in Bulletin 78.
471B Raymond Div.

Mixers.....Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to develop a complete technical description of agitation required for your process, quickly & easily. No. B-107.
215a *Mixing Equipment Co.

Mixers.....Data on turbine & slow speed heavy duty agitators . . . for open & closed tanks. Covers operation & applications of super-turbine & injection mixers, mixer data, mixer drive heads, etc. Bulletin No. 76.
297b *International Engrg.

Mixers.....Mix-Mullers for chemical and process industries. Covers Simpson mulling principle; mulling for dry, wetted and plastic mixtures; Mix-Mullers for special requirements; etc. 12 p. Bulletin No. 522.
303 *National Engrg. Co.

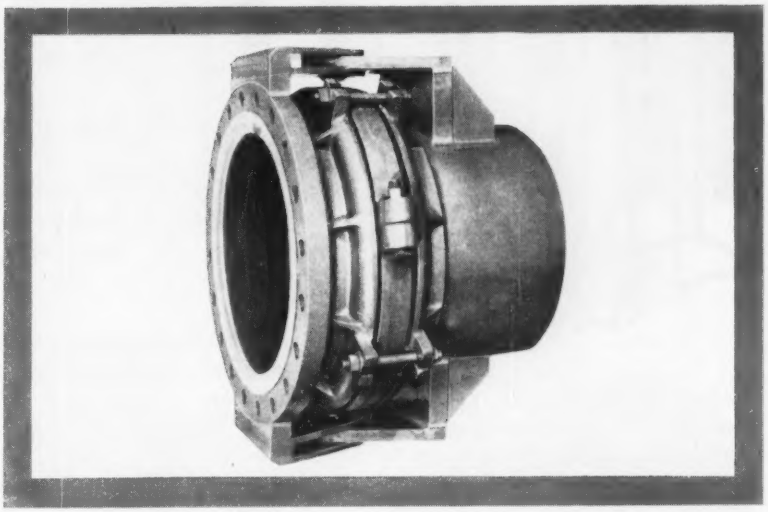
Mixers.....“How to Choose the Right Industrial Mixer” includes data on: correct mixing action; uniformity of batches; conversion of automatic batch operation; maintenance & repair costs; etc. Bulletin R-1701-B1.
471C Worthington Corp.

Mixers, Dry.....Describes conical blenders (design, operation, application, capacity, sizes & specifications) & ribbon mixers (operating & construction features, specifications, etc.). Illustrated Bulletin No. 78.
297c *International Engrg.

* See explanation on p. 446

FLEXON PIPING *Operating Briefs*

How to Handle Angular Motion in Steam and Process Piping



Piping motion where expansion joint flanges do not remain parallel under operating conditions can often be handled best by a Flexon hinged-type expansion joint.

The Flexon hinged-type joint is self-restrained to prevent any thrust from being transmitted to adjacent piping. The economy of the hinged unit comes from the elimination of much of the expensive anchoring and guiding necessary in a conventional installation.

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FLEXONICS
A Single Source for Every Expansion Joint Requirement

Flexonics Corporation manufactures a complete line of expansion joints in free-flexing, controlled-flexing and special types. Sizes range from 3" up.

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makes simple work of Filtering, Mixing, Storing

Regardless of the size or type of your installation, whatever your process may be, there's an Alsop Filter, Mixer, and Storage and Mixing Tank to "fit your job". You can be sure of getting from Alsop the right unit properly applied—you can depend on Alsop proved performance features. Alsop Filters, Mixers, and Tanks are available in a complete range of sizes and capacities, and Alsop Equipment is custom fitted to your application by engineers who have thorough experience in Filtration and Agitation. For full information, recommendations, and quotations write Alsop Engineering Corporation, 1010 White Road, Milldale, Connecticut.

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you believe you can organize and run your own public relations department . . .

you like to meet the press and public . . .

you think fast and accurately . . .

you have writing ability . . . with a technical background that will help you work understandingly with a technical staff . . .

then you may be the very man we're looking for. Won't you write at your earliest convenience, giving full details of your experience, age and salary desired.

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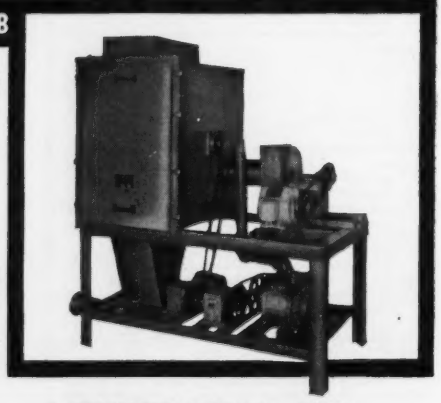
Pocket-Sized DUST COLLECTOR

DOES MAN-SIZED JOB

Newest of the Turner & Haws AEROTURN LINE, the Model D* gives you...



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Pressure-controlled, reverse-air-jet filter cleaning ensures maximum dust separation and highest capacity.

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Unique filter drum design provides large filter area in smallest possible space. High-quality materials and workmanship ensure economical, trouble-free operation.

A COMPLETE PACKAGE, READY TO OPERATE
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Capacities range from 520 to 7200 CFM. Write for free six-page brochure.

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87 Gardner Street, West Roxbury 32, Massachusetts

LITERATURE . . .

Mixers, Paper Coating.....Readco paper coating mixers can be supplied for manual or hydraulic discharge in 150, 350 and 750 gallon working capacities. Request product literature for complete details.
360 *Read Standard Corp.

Mixers, Pipe Line.....Company issues an informative booklet describing the Nettco Flomix . . . a patented and unique pipe line mixer for continuous processing applications. Fully illustrated Bulletin No. 531.
318b *New England Tank & Tower.

Mixers, Portable.....Use in industry reduces costs, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. No. B-108.
215d *Mixing Equipment Co.

Mixers, Portable.....Includes information on the numerous features and advantages, materials of construction, sizes and specifications, portable-permanent mountings, etc., in illustrated Bulletin No. 74-A.
297d *International Engrg.

Mixers, Side Drive.....Presents 8 p. fully illustrated reference covering Nettco side drive with shut-off. Describes how the shut-off operates, numerous advantages, exclusive features, etc. Bulletin No. 532.
318c *New England Tank & Tower.

Mixers, Side Entering.....Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc., in completely illustrated Catalog B-104.
215e *Mixing Equipment Co.

Mixers, Side Entering.....The Type "NU" side entrance mixer is a brand new unique mixer design. It has no cast parts and is of all welded construction, including the stuffing box. Illustrated Bulletin No. 72-A.
297e *International Engrg.

Mixers, Top Entering.....Illustrated and detailed 32 p. Catalog includes advantages, typical installations, mechanical description, construction information, dimensions and selection tables, etc. Catalog No. B-102.
215f *Mixing Equipment Co.

Mixers, Top Entering.....Makes available pertinent information on top-entering mixers (propeller type) . . . for closed tanks, pressure & vacuum . . . for open & loose-covered tanks. Data in Catalog B-103.
215g *Mixing Equipment Co.

Processing Equipment.....Describes corrosion-resistant processing equipment. . . precision built to your specific requirements to give long years of peak performance with low maintenance. Technical Bulletins.
337d *Lee Metal Products Co.

Pulverizers.....Valuable data on Superfine pulverizer . . . a centrifugal air attrition impact pulverizer and classifier in a single unit. Covers numerous features, specifications, construction, etc. Illustrated.
BL351 *Schutz-O'Neill Co.

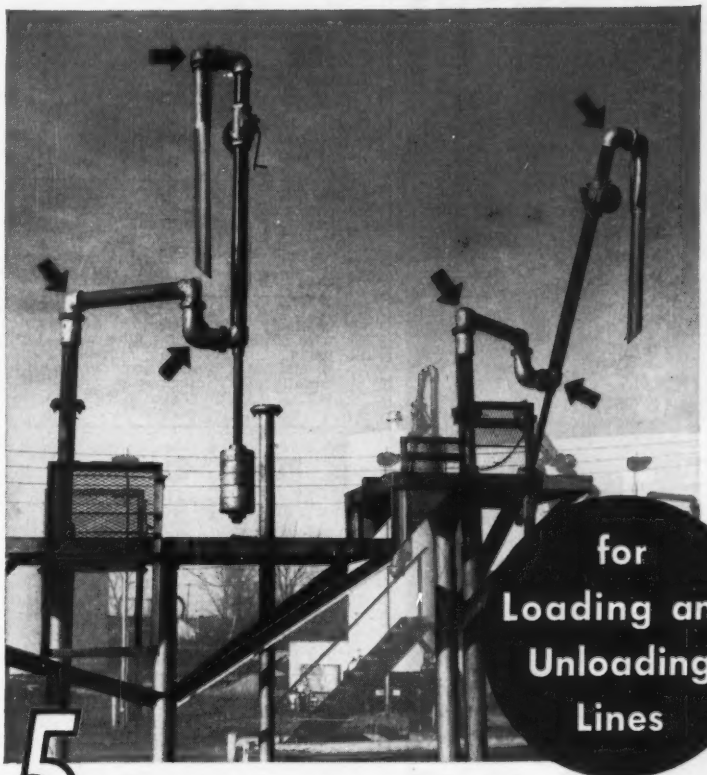
Pulverizing.....Describes Raymond pulverizing, separating and drying units. Every unit is rugged and dependable . . . designed and built to do your job more simply and at a lower cost. Request Bulletin No. 83.
473A Raymond Div.

Reclaimer Systems, Oil.....A simple, economical and efficient method of restoring contaminated lubricating and sealing oil to the full value of new oil. Offers full details on reclaimers in Bulletin R-160.
333 *Hilliard Corp.

Screens, Vibrating.....Announces a new "Aero-Vibe" screen (Model AVS) which utilizes a simplified two-bearing design with counterweight wheels and sturdy bolted construction. Request 12 p. Bulletin No. 07B6099A.
474A Allis-Chalmers Mfg. Co.

* See explanation on p. 446

BARCO Swing Joints and Assemblies



5 Reasons for SUPERIORITY!

1. **BALL BEARING AND O-RING EQUIPPED**—Suitable for handling solvents, naphtha, alcohol, gasoline, liquefied petroleum gases, carbon tetrachloride and many other fluids.
2. **LARGE BEARING SURFACE**—Barco's bearing design provides adequate support for lengths of piping. Minimizes bearing pressures and wear.
3. **CONTROLLED TORQUE**—No annoying, uncontrolled swinging of lines. They swing easily but stay put.
4. **LONG LIFE**—New "Bar-Moly" dry lubricant process gives a permanent anti-galling, corrosive-resistant finish to moving parts. This, combined with routine lubrication, insures longest possible maintenance-free service.
5. **EASY MAINTENANCE**—Joints can be disassembled for inspection without disconnecting piping. O-rings are easily renewable in the field. Frequent greasing not required to maintain sealing.

The Barco line is complete with single swing, double swing, and counter-balance styles and assemblies to meet every need. Sizes 1″, 1½″, 2″, 2½″, 3″, 4″. All steel or malleable iron. Send for latest Catalog No. 400 containing engineering and ordering information. *Worldwide sales and service.*

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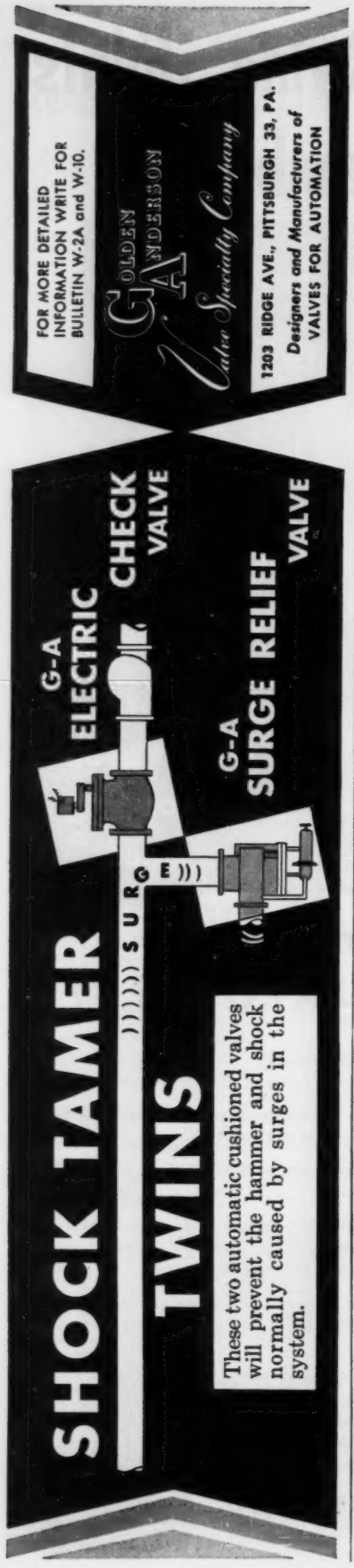
Barrington, Illinois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Designers and Manufacturers of VALVES FOR AUTOMATION
G-A ELECTRIC CHECK VALVE
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TWINS
These two automatic cushioned valves will prevent the hammer and shock normally caused by surges in the system.

LITERATURE . . .

Scrubbers, Fume ..... Fully illustrated, 12 p. reference contains complete technical details on company's line of fume scrubbers and "packaged" scrubbing systems. Includes typical applications. Bulletin 4-R.
474B Schutte & Koerting Co.

Reclamation Systems.....Denver reclamation systems takes dollars out of your wastes—if you have valuable materials in your wastes, these systems can make recovery profitable. Request illustrated literature.
397 *Denver Equipment Co.

Shell-Ice Makers.....If you need broken ice for any purpose—process work, storage, food service or shipping—the facts about Shell-Ice will pleasantly surprise you. Request copy of Frick Bulletin No. 54.
332 *Frick Co.

Strainers.....Rockwell-built Edward strainers for low-cost high performance . . . efficient, inexpensive protection for gages, meters,, regulators, valves, etc. Request Catalog Section No. 12-T.
338a *Edward Valves.

Wire Cloth.....84 p. catalog describes company's facilities for fabricating wire cloth parts. Includes wire cloth parts for screening, filtering and special uses. Also provides helpful metallurgical information.
447 *Cambridge Wire Cloth Co.

Pumps, Blowers, Compressors

Wire Cloth.....Oldest manufacturer of precision wire cloth woven of specified metals for every industrial filtering, straining & sizing operation. Data Book aids in selecting & ordering wire cloth & Screen.
330 *Ludlow-Saylor Wire Cloth Co.

Air Handling Equipment.....Where health, safety and comfort require putting air to work properly, Westinghouse offers you a full line of air moving & air cleaning equipment. Request complete literature.
395 *Westinghouse Elec. Corp.

Blowers, Rotary ..... New illustrated reference shows the versatility of application for Miehle-Dexter blowers. Also describes the newly developed Tandem & Motorized blowers. Tables & graphs. Bulletin 255.
474C Dexter Folder Co.

Compressors.....Covers new line of air & gas compressors, dry vacuum pumps, check valves, aftercoolers & centrifugal pumps for handling water & aqueous solutions. Request 6 p. Catalog Bulletin No. 603.
474D Pa. Pump & Compressor Co.

Blowers.....Precision manufactured to move more gas or air with less wear than other blowers of equal size or weight . . . and with less maintenance and power costs. Describes line in detailed Bulletin B-154.
339 *Read Standard Corp.

Compressors, Balanced/Onposed.....Illustrated, 36 p. describes 300-10,000 hp balanced/opposed compressors—basic principles, drive, design, running gear, lubrication, capabilities, etc. Bulletin L-679-B1.
101 *Worthington Corp.

Pumps.....De Laval Oppeller Pumps are available in sizes from 2 to 4 inches & 2 to 8 stages; capacities to 1000 gpm, pressures to 1200 psig & temperatures to 3500F. Complete details in Catalog No. 1502.
161 *De Laval Steam Turbine Co.

Pumps.....Describes Wheeler-Economy Two-Stage Type DMD pumps. Construction features are illustrated, including dimension tables for various pump sizes. Also suggested applications. Bulletin C-1054.
475A C. H. Wheeler Mfg. Co.

* See explanation on p. 446

Chempro's new Style FM-4 bearings, bushings, washers, etc., have given remarkable service in pumps, mixers and reactors operating under highly corrosive conditions. Made of Teflon,* glass, graphite and an inert lubricant, Style FM-4 bearings and bushings are hard, corrosive-resistant, have a low coefficient of friction, and compare favorably in wearability with those made of metal.

FOR EXAMPLE:

If other bearing materials on your pumps have failed due to corrosion . . . use **FM-4.**

If the shaft bearings on your mixers and reactors must be compatible with the product . . . use **FM-4.**

Also available in rod, tube and cylindrical shapes in a wide range of sizes and wall thicknesses. Our engineers will be glad to assist you in developing the product to meet your specific needs.

Write for Bulletin CP554.

THE ORIGINAL FABRICATORS OF TEFLON PACKINGS AND GASKETS

*duPont Trademark

CHEMICAL & POWER PRODUCTS, Inc.

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PUMP STUFFING BOXES

INFORMATION suggesting solution of common stuffing box difficulties; available in newly revised BULLETIN S-147

Fig. 19,488

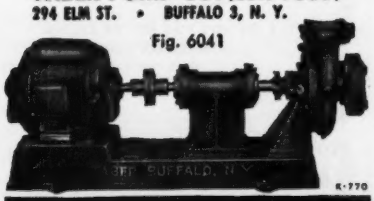
Number of rings, depth of box, type of packing . . . chemical and physical properties of the fluid being pumped, speed of shaft and other pertinent usable facts are in this Bulletin.

WRITE on business stationery for your copy of Bulletin S-147.

TABER PUMP CO. (Est. 1859)

294 ELM ST. • BUFFALO 3, N. Y.

Fig. 6041



S-770

TABER

LITERATURE . . .

Pumps.....Series H Durcopumps, built for continuous operation with maximum service & minimum maintenance, use just three bearing housings & shafts. Available in eleven standard alloys. Bulletin P/8a.
237 *Duriron Co.

Pumps, Acid.....Ace "Wam"—the finest non-metallic acid pump. On job after job, this 80-gpm centrifugal pump has earned highest praise. Handles nearly all corrosives. Full details in Bulletin CE-55.
335e *American Hard Rubber Co.

Pumps, Centrifugal.....Furnishes reference describing the new end suction centrifugal pump. Includes materials of construction, features of design, performance tables, dimensions, etc. Illustrated Bulletin No. 4011.
445 *Deming Co.

Pumps, Centrifugal.....20 p. includes: data & outline drawing of Worthite pumps with standard stuffing box; photos of typical open type impellers; parts list; etc. Request Bulletin No. W-350-B14B.
475B Worthington Corp.

Pumps, Centrifugal.....Impervious graphite pumps feature mechanical seal with enclosed coolant, rugged type SN armored connections, interchangeable parts, wide capacity range, etc. Catalog Section S-7250.
235b *National Carbon Co.

Pumps, Centrifugal.....For water only, this compact unit-type with motor rotor and pump impeller on the same shaft can be mounted and operated in any plane. For full details, request Bulletin No. 240.
475C Pa. Pump & Compressor Co.

Pumps, Centrifugal.....Original manufacturer of self-priming centrifugal pump offers data on new Type CG LaBour—operates under positive or negative suction lift conditions as required. Request Bulletin G-1.
257 *LaBour Co.

Pumps, Centrifugal Chemical.....Worthington offers you the widest standard corrosion-resistant pump line as Karbate impervious graphite supplements Worthite. Request Bulletins W-350-B14A and W-350-B18.
162-3 *Worthington Corp.

Pumps, Chemical.....Furnishes a complete line of Buffalo pumps, ready to handle corrosive or abrasive liquids at least maintenance cost. For full product information, request illustrated Bulletins 976 and 982.
437a *Buffalo Pumps.

Pumps, Controlled Volume.....Describes pump Model H-20 . . . designed for accurate chemical feed at low cost. Includes data on simplex & duplex models, capacities, pressures etc. Illustrated Bulletin H20-1.
475D Milton Roy Co.

Pumps, Close-Coupled.....Feature the "Q" Factor . . . the built-in quality which provides trouble-free satisfaction and long life. Offers complete description of Class CCL close-coupled pumps in Bulletin 975-D.
437a *Buffalo Pumps.

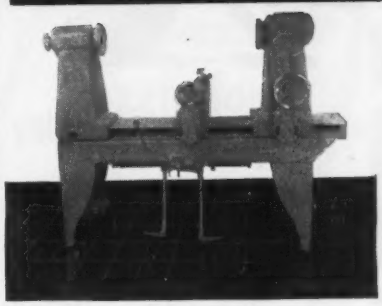
Pumps, High Vacuum ..... Describes complete line of NRC rotary gas ballast pumps—the only pump proven to handle water & other condensable vapors without loss of original high pumping speed. Bulletin No. P-3.
475E Naresco Equipment Corp.

Pumps, Double Suction.....Hydraulically balanced, highly efficient and durable. In sizes to deliver from 10 to 14,000 gpm for circulating, air conditioning, other plant services. Details in Bulletin No. 995-Q.
437b *Buffalo Pumps.

Pumps, Paper Stock.....For handling high consistency liquids—save money and trouble with non-clogging paper stock pumps. Available in alloys or rubber-lined for corrosive and abrasive liquids. Bulletin No. 953.
437e *Buffalo Pumps.

* See explanation on p. 446

GLASS WORKING LATHES



MODEL ME

$3135.00 f.o.b. Grass Valley, Calif.
Especially useful for handling large television Bulbs

GENERAL SPECIFICATIONS

Maximum length overall	84"
Maximum width overall	27"
Maximum length, spindle nose to spindle nose	47"
Height, floor to spindle	52⅜"
Radial clearance above apron	21¼"
Spindle hole diameter	3⅞"
Approximate shipping weight	1800 lbs.
Net weight	1600 lbs.

STANDARD EQUIPMENT

Two face plates
One collet draw-in bar
Hand carburetion control
Foot pedal control of air or nitrogen supply and oxygen-gas volume
Main air valve controlling air in either or both spindles
Standard spindle speeds approx. 30-40-60 RPM. (With Adjusto Spede 17½-175 RPM.)
½ h.p. motor, 220 volt, 3-phase

DO YOU KNOW?

That a first class glassblowing job requires accurate alignment of rotational axes between the headstock and footstock?

That variable spindle speed gives another dimension to your technique?

That simple chucking attachments supply versatility for wide varieties of applications?

That special chucking for your industrial procedures, or laboratory practices are available?

That Litton jet-mix fires are universally used in glassblowing to prevent reducing conditions?

That Litton Lathes have been the standard of the vacuum tube industry for 22 years, and have been constantly improved?

That you can get these precision tools at reasonable cost, in eight sizes, with swing from 8" to 42", and working length from 20" to 75½"?

Let us send you complete specifications and prices on our line of equipment and tools for the Vacuum Tube industry and for general research and development laboratory use.

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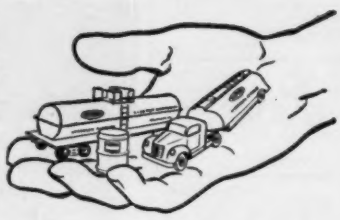
Xtracts

USEFUL INFORMATION ABOUT REACTIVE CHEMICALS FROM DU PONT ELECTROCHEMICALS DEPARTMENT

Hydrogen Peroxide Widely Used in Industry and Chemistry



"Albone," an aqueous hydrogen peroxide solution, is available in grades containing 35% and 50% by weight H_2O_2. It is water-white, extremely stable, and contains no organic stabilizers.

The most outstanding property of hydrogen peroxide is its oxidizing action on both organic and inorganic materials. A particular advantage of this oxidizing action is that no undesirable by-products are formed, since water is the only residue.

Widely used in bleaching textile fibers, wood pulp, fats and oils, wood, etc., it is also a versatile reagent in a large number of chemical reactions.

Under proper conditions, "Albone" oxidizes ferrous iron to ferric iron, nitrites to nitrates, sulfides and sulfites to sulfates, halogen acids to the corresponding halogens (except fluorine), and alcohols and aldehydes to the organic acids or even to carbon dioxide in the presence of certain catalysts. Organic peracids result from the reaction of peroxide with the corresponding acid anhydride.

In contrast to its oxidizing properties, "Albone" has a strong reducing action under some conditions. It reduces cupric salts, silver and gold oxides, vanadic acid, periodates, bromates, and permanganates, generally with a liberation of oxygen.

"Albone," under certain conditions, adds on to ethylenic hydrocarbons to form glycols. With many inorganic oxides and hydroxides, it forms the corresponding peroxides. Most hydrate-forming salts produce perhydrates with hydrogen peroxide. Organic chlorides form organic peroxides, i.e., benzoyl peroxide from benzoyl chloride in an alkaline peroxide medium.

Hydrogen peroxide can be used in acid, neutral, or alkaline solutions. The rate of reaction can be controlled and directed by proper selection of pH, total alkalinity, catalyst, temperature, and concentration.

For more information about properties and applications, send the coupon below.

"Elvanol" Helps Make Stable Emulsions

Just a small amount of "Elvanol" polyvinyl alcohol is all that's needed to make highly stable dispersions or emulsions of mineral and vegetable oils, many resins, waxes, organic solvents, etc. It functions as a protective colloid and surface agent which lowers interfacial tension—thus making emulsions which are resistant to creaming and phase separation. Because it is non-ionic "Elvanol" can be used in acid or alkaline media. In some applications, "Elvanol" serves as a binder and thickener as well as an emulsifying agent. High-quality dispersions can be easily prepared in simple equipment. To meet specific requirements several grades of "Elvanol" are available.

Check coupon for more information.

To Introduce Nitrile Group—Use NaCN

The highly versatile nitrile (CN) group is becoming increasingly important in chemical syntheses. It offers a convenient method for adding another carbon atom to an organic compound and makes possible a variety of reactions leading to a host of products, including dyes, pharmaceuticals, fibers and plastics. Quite often, the most practical way to introduce the (CN) group is through the use of high purity NaCN.

Furan Important Intermediate in Organic Synthesis

Physical Properties

Appearance	Colorless liquid
Odor	Mild, pleasant
Molecular Weight	68.07
Boiling Point	31.3°C. at 760 mm.
Specific Gravity, 20/4	0.937
Index of Refraction, n20/D	1.4214
Flash Point	32°F.

Solubility in H_2O : Approx. 1g./100g. H_2O
Miscible with most common organic solvents.

With its conjugated unsaturation, furan has reaction characteristics somewhat similar to divinyl ether and butadiene, but modified by its cyclic structure. Substitutions, additions, and fission of the ring can be effected depending on conditions employed. The following reactions serve to illustrate the versatility of furan:

Chlorination ——→ **Chlorofurans**
Nitration ——→ **Nitrofuran**
Sulfonation ——→ **2-Furan Sulfonic Acid**
Conversion to other Heterocyclic Compounds ——→ **e. g., Thiophene**
Acylation ——→ **Alkyl and Aryl 2-Furyl Ketones**
Acetalization ——→ **2,5-Dialkoxy-2,5-Dihydrofurans**
Diels-Alder Diene Synthesis ——→ **3,6-Endoxytetrahydrophthalic Anhydride**
Metallation ——→ **2-Furyl Sodium**

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11507 Nemours Bldg., Wilmington, Del.
Please send me literature and information on: (CE-10)

- ☐ Sodium
- ☐ "Albone" Hydrogen Peroxide
- ☐ "Elvanol" polyvinyl alcohol
- ☐ Furan
- ☐ Pyrrolidine
- ☐ Dihydropyran

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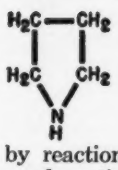
Pyrrolidine



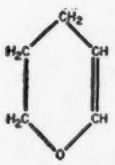
This cyclic secondary amine functions as both a catalyst and reaction intermediate. Unusual compounds can be made by reactions involving addition, condensation, acylation, and alkylation. Highly reactive, this intermediate provides practical routes to useful industrial products, i.e.:

With carbon disulfide, to make *rubber accelerators* similar to those obtained from piperidine.

With alkyl halides, it gives N-alkyl pyrrolidines which can be converted to quaternary bases useful as *sterilizers* and *surfactants*.

Introduction of the pyrrolidyl ring, a physiologically active nucleus found in many natural products such as alkaloids. With ethylene oxide, N-hydroxyethyl pyrrolidine is formed. *Send for Bulletin No.* 28.

Dihydropyran



Colorless liquid.
B.P. . . . . 86°C.
Flash point . –18°C.
Solubility in water at 20°C., 3 g./100 g.
Miscible with common organic solvents.

The reactivity of the double bond makes possible a wide variety of addition compounds. Hydrogenation yields tetrahydropyran, an excellent solvent and chemical intermediate. The following reactions suggest applications for dihydropyran as an intermediate:

With Mono- and Polyhydroxy Compounds .. Tetrahydropyryl Ethers
With Hydrogen Bromide 2-Bromotetrahydropyran
Chlorination 2, 3-Dichlorotetrahydropyran
Hydrolysis ..... Deltahydroxyvaleraldehyde

Write for Bulletin No. 18.

LITERATURE . . .

Pumps, Sealless.....Combining motor & pump in a single unit, Chempump is most significant advance in pump design in half a century. Hard-to-handle fluids can't leak or become contaminated. 16 p. Bulletin 1010.
38 *Chempump Corp.

Pumps, Slurry & Sludge.....Where abrasive wear is usually severe or could cause severe damage if the casing wore out, a Lawrence Lined Slurry Pump provides the answer. Full details in Bulletin 207-4.
329 *Lawrence Pumps.

Pumps, Stock.....Booklets cover a wide range of stock pumps for pulp & paper mill services. Includes specifications, sectional views with indicated features, dimension charts, etc. Bulletins 231, 235, 243.
477A Warren Steam Pump Co.

Services, Processes, Misc.

Ammonia Production, Synthetic ..... How high yields, low operating costs, and flexibility of plant design can be obtained in the production of synthetic ammonia is the subject of a new 12 p. illustrated booklet.
477B M. W. Kellogg Co.

Autopositive Paper.....Describes Kodagraph autopositive paper—the "big new plus" in engineering drawing reproduction. "New Short Cuts & Savings" shows all the ways you can save with autopositive paper.
79 *Eastman Kodak Co.

Commercial Development ..... Involves establishing a product, a process, markets & raw materials. It requires an integrated program. Illustrated, 4 p. Folder describes the work ADL performs along these lines.
477C Arthur D. Little.

Continuous Processing ..... Describes distinguishing characteristics, capacities & applications of Dorr-Oliver equipment available & outlines scope of D-O technical services. Illustrated Bulletin No. 7003.
477D Dorr-Oliver, Inc.

Engineering Services.....Help protect your equipment investment—application engineering, analytical engineering, product development, field-service enginering, maintenance service, etc. Brochure GED-2244.
47-50b *General Elec. Co.

Filter Aids.....For clearest filtration, use Solka-Floc filter aid. 99.5% chemically pure cellulose, Solka-Floc comes in a wide range of grades to meet your specific needs. Request literature and samples.
340 *Brown Co.

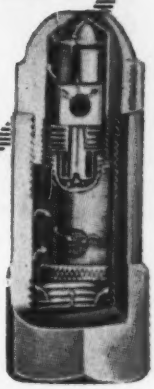
Fire Extinguishing Systems.....36 p. contains information about Foamite Airfoam fire extinguishing equipment . . . for combatting various types of flammable liquid fires. Features numerous illustrations.
477E American LaFrance Corp.

Fire Protection Systems.....Automatic fog system protects you around the clock, sounding alarms & putting water to work instantly wherever & whenever needed. "Fire Can Destroy Your Business" upon request.
52 *Blaw-Knox Co.

Goggles, Safety.....Newly designed and engineered—with greater protection than ever—greater field of vision than ever—more wearer acceptability — many new features — etc. Illustrated Brochure.
290-1 *American Optical Co.

*See explanation on p. 446

There's a Monarch nozzle for every spray job!



If the liquid can be sprayed with direct-pressure rely on MONARCH advanced-design NOZZLES

Many industries make MONARCH Spray NOZZLES standard equipment for

★ ACID CHAMBERS
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★ CHEMICAL PROCESSING
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★ DESUPERHEATING
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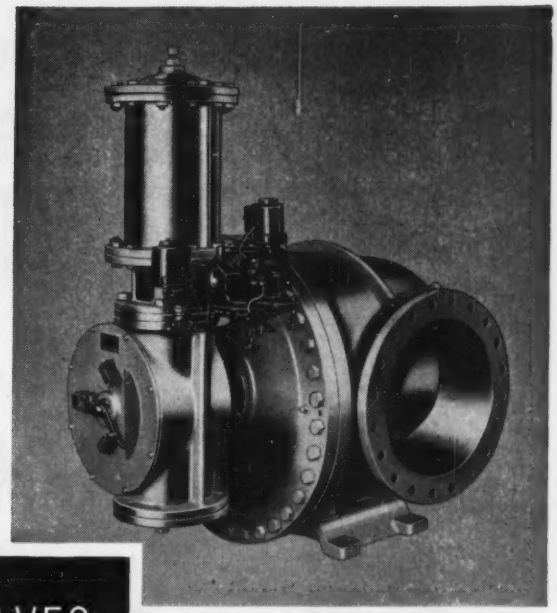

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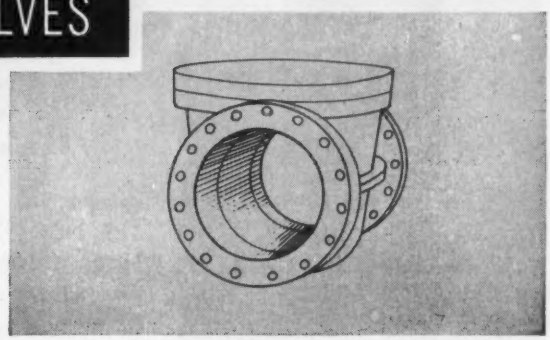

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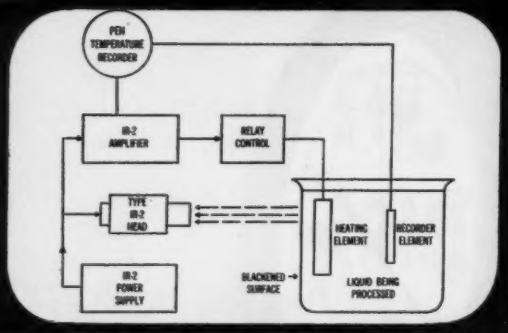
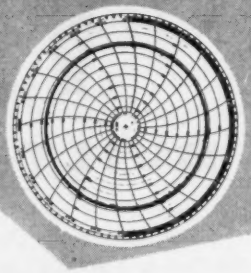


Here's an actual set-up with a standard Servotherm® IR-2 Infrared Radiation Pyrometer System for the remote temperature control of a liquid in process. The optimum temperature of 54°C. for the liquid, had to be maintained within the limits of ±1% over a period of 24 hours. (Note that the focusing range of the Pyrometer head is variable—from two feet to infinity.)

You can see from the recording chart how very successfully the Servotherm IR-2 met these specifications.



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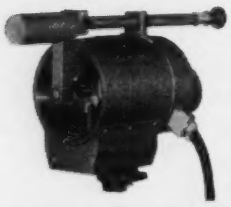

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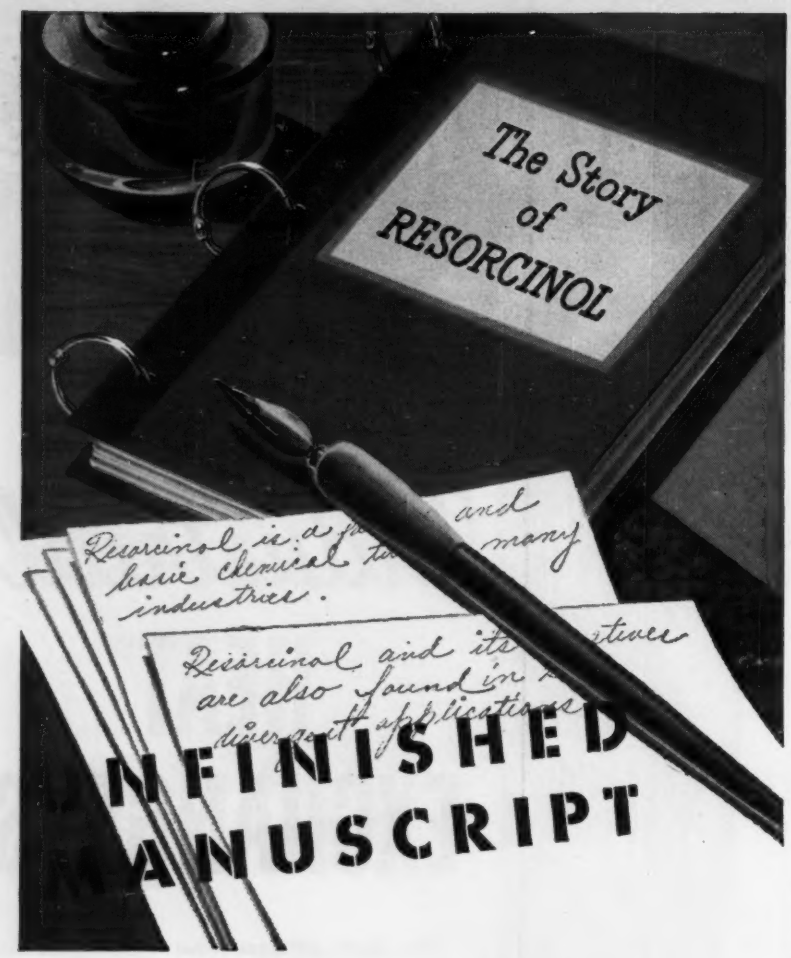

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15	63	92	146D	223	264E	294c	326	BL351	400	447H	452E	458D	TL465b	474A	
16	64	93	147	224-5	265	294d	327	R351	401	4471	453F	458E	TL465c	474B	
17	65	94-5	148A	227	266A	294e	329	352	437a	447J	452G	458F	BL465	474C	
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28e	74	115	150E	235d	268B	297d	335c	356	443	448G	453B	460D	TL467	475E	
28f	75a	117	150F	235e	268C	297e	335d	TR357	444	448H	453C	460E	BL467	476a	
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29b	75c	119b	150H	235g	270A	299	337a	358	446A	448J	453E	460G	468A	476c	
29c	75d	119c	150I	237	270B	300-1	337b	360	446B	BL449	453G	461	468B	476d	
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33	75f	119e	153	241	270D	303	337d	364	446D	450	453I	461B	468D	L477b	
34	75g	119f	156	243	271a	304	338a	366	446E	450A	453J	461C	469	R477	
35	76a	119g	157a	244-5	271b	305	338b	368	446F	450B	454	461D	469A	477A	
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43	80-1	129	162-3	257	272F	311a	343b	375	446L	450H	455C	462C	470A	480	
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51	86-7	139	215a	261	281	312d	344	386	446Q	450M	456C	463C			

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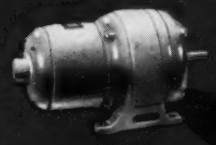

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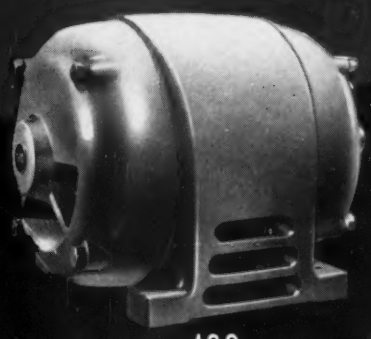
2 to 20 horsepower



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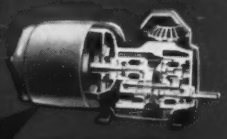

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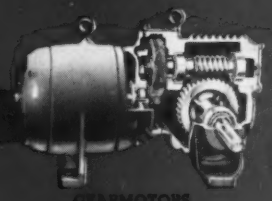
For mechanical or electronic controlled variable speed



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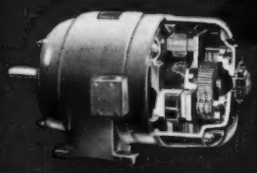
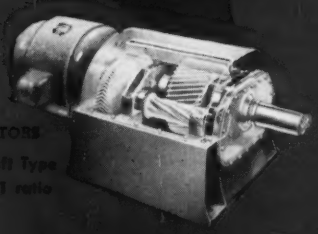


BRAKE MOTORS
Either Magnetic or Dynamic Types



GEARMOTORS
Parallel Shaft Type
up to 120:1 ratio

Corrosioneering News

Quick facts about the services and equipment Pfaudler offers to help you reduce corrosion and processing cost.

3,000- to 4,000-gallon glassed reactors now offered in low-cost *standard* designs

Smashing the size barrier, The Pfaudler Co. now fabricates glassed steel reaction kettles in the 3,000- to 4,000-gallon range – as *standard* models.

This use of standard designs saves you money because it eliminates special engineering. And it saves time because it uses stock parts and standard accessories.

Of course, where your requirements are of a special nature, special refinements are available, as well as entirely custom-engineered reactors up to 7,500 gallons.

Space-saving drive support

Drive is rigidly supported on a separable center cover, making other top head openings easily accessible and leaving plenty of space for all nozzles usually required.

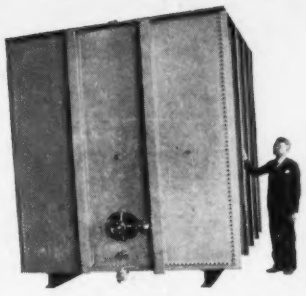
Nine openings—various sizes

You get the full advantage of versatile glassed steel because the top head is equipped with nine nozzles, in several sizes, to facilitate adapting the unit to a wide variety of processes.

Other advantages

Offset bottom outlet, efficient jacket provides clean-out ports. Pfaudler agitating nozzles and many other plus values are available in these new standard model reactors. Your Pfaudler representative has all the facts. Write or call him.

This glassed steel reactor at Schenectady Varnish Co. incorporates these new standard features. Note its compact drive support, leaving ample head space for other equipment. Left of drive is a glassed steel column, 18" dia., for calcium chloride; right foreground is 14" glassed steel hopper for adding catalyst.



Pfaudler rectangular tank.

Endless variety of storage problems solved with glassed steel

You can make efficient use of floor space with one of the many Pfaudler glassed steel tank designs up to 35,000 gallons; cylindrical tanks (horizontal or vertical), rectangular tanks that utilize every inch of floor area and head room, and square panel vats that can be assembled on the spot.

The smooth surface of Pfaudler tanks is extremely easy to clean because almost nothing sticks to glass, besides being corrosion resistant.

The glass-to-steel bond is actually a *chemical* union of the two materials – so strong that in tests a force of 1,500 lbs. per sq. in. was unable to separate them. Thus you need not fear any peeling off of the inner lining. Thus you are able to handle liquids and solvents through a wider temperature range than with other types of lined tanks.

New fractionating assembly is small but highly effective

Here is a small fractionation assembly, in "packaged" form, that can easily put you on the road to solvent recovery without putting too big a crimp in your budget.

It makes use of a glassed steel still and column, to provide maximum corrosion resistance where there is acid present in the batch. This makes the assembly highly practical for such materials as methanol, ethanol, acetone, and ethylene dichloride.

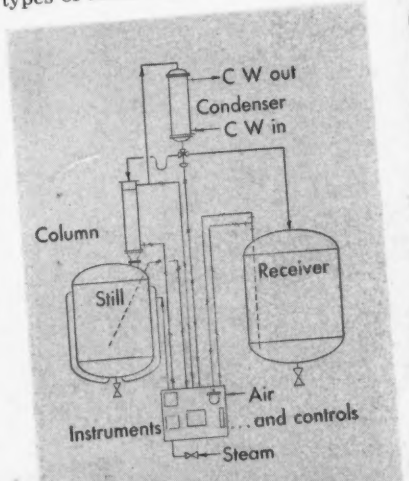
Because the acid remains in the still, the condenser is fabricated from type 316 stainless steel. A glassed steel vacuum receiver is provided for maximum service life, versatility and product purity.

With this assembly, Pfaudler can actually give you a *guarantee* of performance for a specific separation. For example, if you wanted to recover 90% methanol from a charge containing 50% methanol, simple distillation would produce, at best, 65% recovery in a concentration of 60%, and some contamination would result.

Pfaudler is able to guarantee recovery of over 95% of the methanol in the charge, in a concentration of at least 90%, and essentially acid-free.

Low cost is another important advantage of this system. By providing a standard "packaged" assembly, Pfaudler has been able to eliminate most engineering charges involved in developing an assembly especially for your specific operation.

Your Pfaudler representative can answer your specific questions. Call or write him.



SMALL FRACTIONATION SYSTEM IS DELIVERED COMPLETE WITH CONTROLS

Pfaudler

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